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THE BEGINNINGS OF PLASTIC ART IN EUROPE.

It is not very generally known, what remarkable examples of primitive art-life Europe produced before the classic art of antiquity flourished in Greece, and passed through Italy, to enter upon its triumphant course through the whole civilized world. Art-histories usually begin with the Orient, pass then to Greece and Italy, and, only when finally they reach the Roman Empire, or the Middle Ages, have they an opportunity of presenting the art of Northern Europe to the reader. This treatment corresponds, in effect, with the development and the progress of great historical and monumental art.

Archæological investigations have unearthed in the last decades numerous memorials of European prehistoric art. These examples are works partly of

FIG. 1.—IVORY TORSO FROM BRASSEMPOUY.

FIG. 2.—DESIGN ROLLED INTO A STAFF.

FIG. 3.—A CLAY HEAD FROM BUTMIR (BOSNIA).

FIG. 6.—CLAY FIGURE FROM A BŒOTIAN TOMB. (One-quarter natural size.)

FIG. 4.—CLAY IDOL FROM A THRACIAN BURIAL MOUND.

FIG. 5.—A MARBLE STATUETTE FROM KEROS.

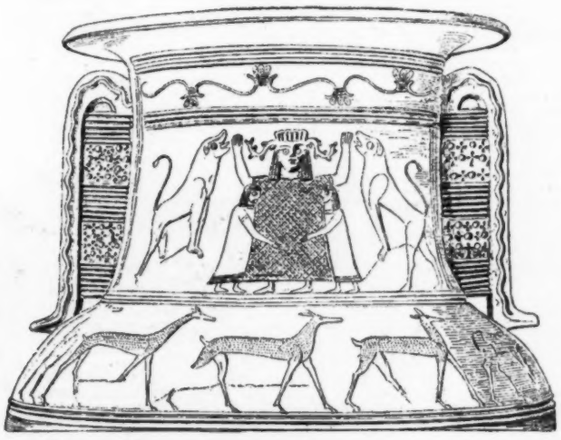


FIG. 9.—UPPER PORTION OF A CLAY AMPHORA FROM A BŒOTIAN TOMB.

FIG. 7.—A BRONZE FIGURE FROM NOVILARA.

FIG. 8.—AN AMBER IDOL.

FIG. 10.—A GOLDEN ORNAMENT FROM ÆGINA.

FIG. 11.—A FERRYMAN OF THE DEAD, FROM A NORTH SYRIAN BRONZE RELIEF.

FIG. 12.—SARDINIAN SCARAB.

FIG. 13.—PENDENT ORNAMENT FROM MERAN.

EXAMPLES OF PRIMITIVE ART IN EUROPE.

astonishing talent, partly of the grossest crudeness; works modeled after nature with considerable truth, and with some elegance; and works most ridiculous in their distorted forms.

The history of pre-classic art in Europe falls into two great divisions. The first embraces the period extending through unnumbered millenniums, from the earliest evidences of an artistic sense in man of the hunting-period, to the appearance of the later, more advanced economic forms of the agricultural and pastoral periods. The second division, therefore, comprises the period from the rise of the agricultural and pastoral periods to the development of the classic art of antiquity in the South, and to the dispersion of this art over other parts of the continent.

Schliemann's spade has unearthed in Asia Minor and

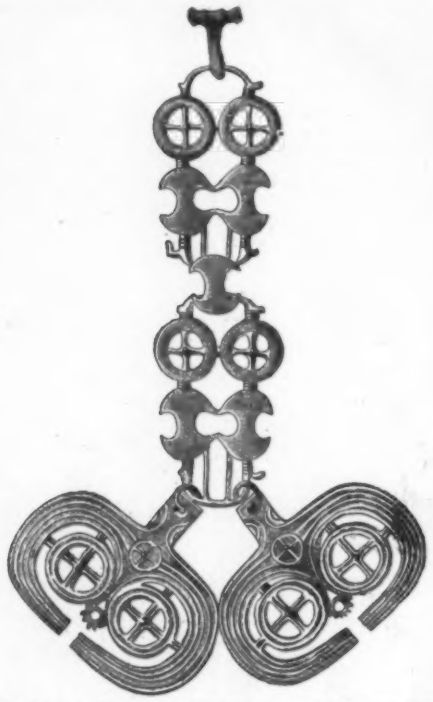


FIG. 14.—A BRONZE ORNAMENT FROM HUNGARY.
(One-half natural size.)

in Greece, strata bearing the marks of a civilization of very great age; but these strata date from relatively advanced stages of civilization, and by no means extend back to the time when man, as a restless hunter, slew the mammoth and the reindeer, lived in caves to protect himself from the climate, or set up his mean tent under the open skies. But from this very latter period it is, that a great number of the most remarkable relics date—relics which prove that man of this stage of civilization was turning to realism and to the representation of objects which interested him chiefly as a man and as a hunter.

Then follows a time of apparent sterility and of sluggish persistency upon a very low stage of art. But in this period the foundations of later economical development, of social and religious order, of industry and of art, were laid. Art, in its way, reflects in a mirror as it were this entire development, and takes the place, to a certain extent, of the lacking literary documents of this primitive time. A thousand years before the time of Herodotus, the oldest Greek historian whose works have come down to us, Mycenæan civilization flourished in Greece and completed the second preliminary stage (Vorstufe) of historic life in Europe. In this period ripened the first great fruit of the blending of Oriental influences and European national force (Volkskraft). The after-effects of Mycenæan civilization were felt, not only within the confines of Greece, but far beyond the age to which they properly belonged; they can be clearly traced even to the Kelts of the last century before Christ.

The foregoing facts have been condensed by the Illustrirte Zeitung from a recently published work by Dr. M. Hoernes, Custodian of the Prehistoric Division of the Royal Museum of Natural History in Vienna.

Of the accompanying illustrations, reproduced from Dr. Hoernes' book, Figs. 1 and 2 represent characteristic works from the hunting-period, and picture a nude female torso and the impressed ornamentation of a so-called "Commander's staff" (Commandostab) rolled into reindeer horn. The pieces are carved out of mammoth ivory, and prove from the very material of which they are made, that at this period the geographic relations of animals in Europe were different than now. Both of these pieces were found in French cave-strata of the early stone-age. The art of this period, in plastics as well as in design, is bold, naturalistic, but without pronounced merit.

The art of the later stone-period and that of the bronze-age is diametrically opposed to that of the bold beginnings of the mammoth and reindeer hunters. The work is stiff, schematic, more indicative than executive, in its best examples painfully overwrought, and, as a rule, crude and coarse. These characteristics are present in a head found in Butmir, in Bosnia (Fig. 3); in the clay idols from Cyprian, Thracian, and Servian tombs (Fig. 4); and in the remarkable statuette of a seated harp player from Keros on the Ægean Sea (Fig. 5). Man of the pastoral and agricultural periods created these works and hundreds more like them. But in these primitive productions, crude as they are, no small progress is displayed. The relics have been mostly obtained from tombs and are evidences of a religious art, of an art which endeavors to symbolize a high, spiritual ideal. A

FIG. 15.—BRONZE BUCKET-COVER FROM STYRIA.
(One-third natural size.)

great, motherly divinity, mistress of life and death, ruling the clod which absorbs the seed that has been sown and which covers the dead, is the favorite subject of these works. This highly revered divinity appears in many forms throughout the bronze-age and Mycenæan period, and in the last millennium before Christ. From a Greek tomb the bell-formed clay figure shown in Fig. 6 was obtained; from Italian tombs the bronze figure represented in Fig. 7, and the amber idol in Fig. 8. Idols of this character were set up in the home or were worn as a protecting talisman; without such customs plastics of the later economic stages would not have arisen. In painting and designing we also encounter the same divine form. For example, it is present in the clay receptacle represented in Fig. 9, which was found in a Greek tomb.

Other small figures in clay and bronze were the votive gifts to the gods. These works chiefly represented animals and were discovered in large quantities in sacred spots where erstwhile world-famed sanctuaries stood. Such pieces are, for example, found in Olympia.

Thanks to the revived and young national genius (Volksgeist) of the Greeks, the art of the Mycenæan period bursts through the stiffness of the schematic art-tendency with the inspiration of a new, higher life. In addition to the production of small figures, for the most part decorative, in which, as in the golden ornament of Fig. 10, there glimmers a religious signification, the art of this period produced copies of scenes from active life, of hunts, combats, and the like, all represented with great boldness and realism.

The geometrical period of Greek art extends through the centuries from the extinguishment of the Mycenæan tendency to the birth of a new style Oriental in its influence—a style which is the immediate forerunner of the grand classic art of the fifth century B. C. The art of the period inherited the legacy of the Mycenæan age and has transmitted this legacy to following ages, although it embodies a principle of style directly opposed to that of Mycenæan art. Thus we see how Greek art of the second half of the century of the last millennium before Christ has a long and eventful prehistory, the phases of which are represented as a series of technical and stylistic advances.

While Greece passed through a period which directed the development of later times, the rest of Europe remained not unaffected by foreign tendencies. In what manner purely Oriental works directly influenced Italic bronze work is seen in the relief represented in Fig. 11 and in the scarab in Fig. 12; the latter, like the Meran amulet (Fig. 13), represents a talismanic form, which later, losing its deeper meaning, became purely ornamental in character. Here belong the Hungarian bronze piece of Fig. 14 and the wheel-ornamented Styrian bucket-cover (Fig. 15). The bronze and clay receptacles are decorated not figuratively, but geometrically. In a single Carinthinian region (Frög) small equestrian and avian figures are found exclusively. The greater part of these and similar objects are obtained from tombs of the early iron-age.

Figural markings, sometimes longer series of pictures such as were found in the bold designs of Mycenæan art, now occur beyond the borders of Greece. They are found on the clay vessels of western Prussia and of Holstein, on engraved bronze girdles of the Caucasus, and on tombstones in eastern Italy (Fig. 16). The influence of Mycenæan art is here noticeable. A class of widely distributed Venetian bronzes ornamented with rows of figures tell of the effect of the refining art of Greece on the barbarian world.

It is evident that, of the two great branches of plastic art, the first division is the older and more honorable. And how could it be otherwise, since religious works of art were in the beginning held to be animated, and since animation in a free plastic work seems more natural than in a mere design at the most only decorative?

The human soul in art, as well as in other fields, has torn itself away from superstition and narrow environments, and has attained to a knowledge of its higher goal. In the beginning coarsely sensual, later superspiritual, these works of plastic art, although many of them to this day serve the old, humble purposes among uncivilized and civilized peoples, have finally conquered the place which justly belongs to them. They serve to glorify the sensuous world and to sensualize the supersensuous (übersinnlich), in order that art everywhere in higher civilization may occupy a brilliant mediate position between science and religion.

FIG. 16.—A TOMBSTONE FROM NOVILARA, NEAR PESARO.

THE MINERAL RESOURCES OF CUBA.*

By RAIMUNDO CABRERA.

THE mineral resources of Cuba have always been subordinated to the agricultural, and the island has not been considered a mineral country. In fact, the only deposits which have been worked on a commercial scale have been the iron ores. The development of such resources has been hindered by maladministration and excessive taxation, which have prevented the investment of capital in mining works.

The minerals which had been more or less constantly mined in Cuba, up to the outbreak of the late revolution in February, 1895, were the following:

1. Asphaltum and mineral oils.
2. Copper.
3. Iron.
4. Manganese.
5. Gold.

1. The deposits of hydrocarbons, asphalt, and mineral oils are abundant and of excellent quality, both for fuel and lighting purposes. They are present in various conditions, solid, plastic, and liquid, and several experts have affirmed "the existence at a great depth of very light oils, petroleum, or naphtha." Of these, however, no definite investigations have been made, nor scarcely any examinations beyond such as are incidental to a very primitive stage of industry. On the Motembo estate, Province of Santa Clara, at a location named San Juan, borings were made in 1881 which resulted in discovering, at a depth of 95 meters, a deposit of naphtha of extraordinary purity, colorless, transparent as water, inflammable, leaving no residue after combustion, and of a density of 0·754, which congealed at a temperature of 85° C., dissolved asphaltum and the resins, and which was so volatile that its vapor at ordinary temperature could be utilized as illuminating gas. Nevertheless, this well was abandoned after the workings had reached a depth of 290 meters, although the supply continued at that depth.

A well similar to that of Motembo was discovered at Lagumillas, Province of Matanzas, from which, out of a source at a depth of 25 meters (82 feet), there overflowed a supply of 70 liters (18½ gallons) per day. This also has never been further explored or worked.

In the same province, at scarcely a kilometer from the northern coast, there exists a deposit of bituminous shale impregnated with asphaltum of a high degree of purity and in great abundance, whose workings, though favored by facilities of transportation, have also been abandoned. But even at the Bay of Cardenas, in the Province of Havana itself, there has been found a similar deposit. This latter appears, from contemporary mollusks and coral embedded in it, to be of comparatively recent geologic age.

In the rocks underlying a large extent of the bottom of this bay are great masses of asphaltum in a liquid state, having in places a thickness of 70 feet, and quantities of this have been carried to market in New York, where it was highly appreciated for its purity, and was sold at prices varying from $80 to $120 per ton. The exploitation of these deposits in the layers at shallow depths was begun with considerable success; but the enterprise languished for want of facilities, and eventually failed entirely through legislative interference inevitable in that country.

Asphaltum is to be found extensively in the Provinces of Havana and Pinar del Rio. In the former there are being worked the mines of Potosi and Santa Rosa, distant half a league by rail from the harbor of Ha-

* Abstract of lecture before the Franklin Institute, Philadelphia.

vana. The deposits exploited are embedded in the cretaceous marls and the serpentines which are met with in the northern districts, the strata running generally N.W. and S.E., in veins of about 6 meters. The material is earthy and impure, but is advantageously utilized as fuel in grates and ordinary stoves. The mineral is worked in a very crude manner, in the open air, and small quantities of the product have been exported annually. In Pinar del Rio are the Canas and Tomasitas mines, close to the bay of Mariel. These mines are notable for their size, the veins being 35 feet wide, and from 45 to 90 feet deep. They produce over 1,300 tons annually, destined for the use of near-by plantations, whose owners combine in working the deposits, the operations all being carried on in the open air. Asphaltum, or "chapapote," as it is called in the country, is very abundant in the Vuelta Abajo, where it commonly occurs spread on the ground as it has been disengaged from the rocks. There are many smaller workings, among them that of Santa Helena, at Bahia Honda, which district contains unworked deposits of an asphaltum of great brilliancy and purity.

2. Copper has been mined on a larger scale than any other of the mineral resources of Cuba, particularly in the Province of Santiago de Cuba. The town of Cobre takes its name from the adjacent mines, which were worked by a corporation known as the "Consolidado." These mines were discovered about the middle of the sixteenth century, but their working was reserved for itself by the Spanish government, with the result simply of giving them over to various contractors. Subsequent to 1833, and after much tribulation and expense, the Consolidado Company discovered some large lodes, and this not only gave that enterprise a great impetus, but also stimulated competing enterprises, one of which undertook the development of a number of mines, under the ownership of an English syndicate, with a capital of $300,000, and named the Santiago Company.

The mines of Cobre, of which the machinery and outfittings were destroyed by the insurgents during the so-called Ten Years' War, and the workings wholly abandoned, were subsequently acquired, during the succeeding interregnum of peace, by the Cobre Railroad Company, which energetically undertook the re-establishment of the plant. The company constructed five iron bridges, equipped the workings with tramways, rolling stock and locomotives, importing the material requisite for the purpose, but the efforts thus put forth remained unproductive, and the enterprise was practically abandoned, solely because of the obstacles created by the administration. The exploitation of the mines has dwindled to the working of the tailings of the early rich outputs. Other veins are being worked in a more or less primitive way, utilizing the waters which filter from the cavities of former workings, precipitating the copper by means of iron and thus obtaining the copper in a refined state.

The cupriferous zone of Santiago de Cuba embraces three divisions: the district of Coney, that of the Cauto, and the district of Cobre. The two former remained unworked; the owners of the mining rights appear to be content to preserve their franchises awaiting better times, having assured themselves of the existence in their concessions of veins of native copper, and of its sulphides, oxides, and other forms.

According to the report of Senor Saltarain, "quite superficial diggings have disclosed a ferruginous ridge of 8 meters width, traversed by veins of copper sulphide, copper oxide, carbonate of copper, copper pyrites, and native copper, all the veins rich in mineral contents, and which at bottom are probably joined in a single lode of copper sulphide, as suggested by a study of the mines of La Caridad, opened in 1882, of those of Portes and others, and of the associated minerals."

In the Province of Santa Clara mining concessions have also been allotted, notably at Malejas and at Nicaragua, which have been superficially worked. Finally, in the Provinces of Matanzas and of Pinar del Rio, considerable copper deposits have been found, the mining of which, occasionally attempted by some crude worker, was always very soon abandoned.

3. Iron.—The Province of Santiago de Cuba has the most extensive deposits. Numerous mining concessions have been granted in this vicinity, divided into some 16 groups, named, respectively, from the towns around which they center; but, of all these concessions, only three are being actually worked, and these by an American corporation, the Juragua Iron Company. This concern has undertaken operations of genuine importance in the mines named Juragua, not only as regards the mining itself, but also in the transportation of the mineral to the coast and the shipment of the ore at the wharves. For this purpose a railroad, several bridges, and extensive wharves have been constructed at a point called Cruz, on Santiago Bay, where the ore is loaded into vessels carrying about 2,500 tons. The success attained by this company, whose output has grown from 21,798 tons, in 1884, to nearly 350,000 tons, in 1893, stimulated the inception of other similar enterprises in the district of Santiago de Cuba.

A number of other corporations have been organized by foreign capital, notably the Spanish-American Iron Company, which has undertaken the building of a railroad of 6 kilometers length to the mouth of the Daiquiri, and the establishment by dredging and other works of an artificial port at that place, and the Sigua Iron Company, which has begun the working of several mines in the group of Arroyo de la Plata. The total exportation of iron ore from Santiago, since the mines were opened in 1884, has been upward of 3,000,000 tons.

4. Manganese also is extremely abundant in Santiago de Cuba; numerous claims for the mining of this mineral have there been located, and a few of them recently put into operation. At Alto Songo veins of manganese dioxide (pyrolusite) are developed to a considerable extent in red jasper and metamorphic formations. The mineral sites of Santa Margarita, Isabelita, Bostoyo and other localities, have revealed important deposits, though but slight effort has been given to develop them. The most notable workings at the present time are those of Cristo and of Ponipo.

In general the manganese deposits are worked by people who take them under the lease from the proprietors, paying a royalty. Thus the mining proceeds on a trifling scale, being further restricted by the difficulties of transportation, which is mostly by means of ox carts over miserable roads. Many important mines have had to be abandoned simply because the cost of transportation to the place of shipment, though over but a short distance, made the product unavailable.

5. Gold, which abounds in the provinces of Santa Clara and Santiago de Cuba, has not up to the present time afforded any contribution to the public wealth or general industry of Cuba. All the various explorations and individual prospectings which have demonstrated the existence of veins of this metal have resulted in nothing, for lack of capital and means of operation. In the district of Placetas, near Guaracabuya, there are a number of mineral sites. In 1865 explorations were renewed to determine the extent and depth of the gold lodes in Guaracabuya, and according to the report made by Senor Saltarain, mining engineer, these investigations indicated the existence of three distinct lodes. But the workings begun were soon abandoned, not only for lack of adequate means and appliances, but by reason of the revolutionary convulsions that began in 1868.

A similar fate befell the mines of Las Meloneras and of El Descanso, in the same province, and those of Holguin, in the Province of Santiago de Cuba. At the latter place, according to the reports of Senor Fernandez de Castro, of Leon Owen, an English mining engineer, and of other experts, there exist a number of gold deposits, among them that of Monte Verde, in the Guayavales section, where there are three veins that have been worked in former generations. Several remains of ancient workings have indicated that these deposits were mined by the aborigines. Besides the quartz veins referred to, there are to be found in the bottoms of ravines and mountain glens alluvial or placer deposits of gold.

Other Minerals.—Mines of other minerals exist. Sixty kilometers distant from Santiago de Cuba there is a group of ten mineral sites spread over an area of some 4,000 acres, the property of Don Julio Aurich, the mineral from which contains 34 per cent. of iron and 28 per cent. of manganese. These deposits are not worked. Limonite is found in various deposits in Baracoa, where it has been discovered in strata in the ridges bordering the seashore.

Chrome iron is also to be found in the district of Baracoa, where three mining claims have been taken up. The analysis of the mineral from the Valhourat mine, made in the Paris School of Mines, showed the presence of chrome oxide to the extent of nearly 58 per cent. Other mines of this mineral have been located at Mayari and at Sagua de Tanamo, in both of which localities it is very abundant. In Bayamo, in the precint of Vavecito, there is a tract of 84 hectares (170 acres) of lead ore, and two other sites of this mineral in the same vicinity show veins of some 50 centimeters width. In the district of El Cobre, precinct of Sevilla, there is a deposit of argentiferous lead covering some 150 acres. Of this class of mineral numerous mining claims have been taken up, all of which remain unworked.

Of asbestos, two mining concessions have been granted at Mayari, both covering 120 hectares (300 acres). This mineral also appears in abundance at Holguin, in the Nuevo Potosi mine.

The granites and marbles of Cuba have also been worked to a limited extent. In the adjacent Isle of Pines, off the southern coast of the Province of Havana, the quarrying of some remarkably fine marble, both white and veined, was undertaken, and the product was regarded by experts as equal in quality to that of Carrara and of Mexico; but the enterprise failed almost in its incipiency for want of laborers, as well as of means of carriage and of transportation to market.

A NEW FRUIT.*

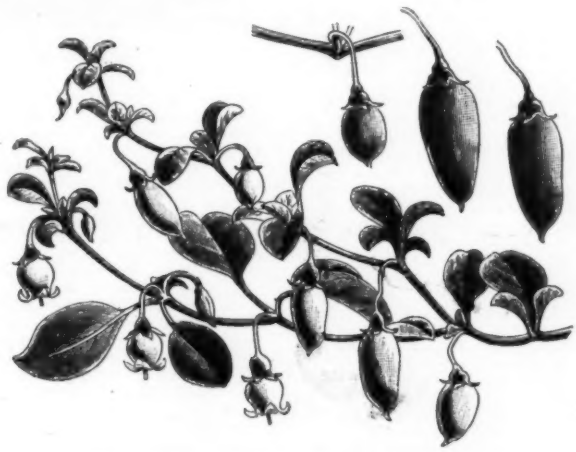
A BUMPTIOUS traveler once told the late Dr. Lindley that there were many splendid edible fruits in the tropics he had visited. "Oh, yes," said the doctor, tartly, "and very few of them are worth eating, I suppose." Be this as it may, in such cases no one is really convinced without actual trial, and an actual trial of the much talked of "Œufs de Coque" convinces me that it is just worth tasting now and then, but that as a useful fruit it will, in British gardens, at any rate, rank a long way down below the gooseberry, or even the wild blackberry of our own hedgerows and fields or lanes.

It is a native of the Argentine, where it forms spreading masses on the bare hot ground, and fruits very freely. The plant forms a straggling, prostrate, bushy mass, its flexuose stems being set with soft small rounded or ovate leaves, and in the axils of the upper branchlets little white, solitary bell-shaped flowers are produced, not unlike those of the wild lily of the valley in form and color. The flowers are visited freely by flies and bees in our gardens here at home, and are followed by ovoid fruits about the size of a small olive, the skin being, when ripe, pale yellow, and filled with soft pulp and seeds. The flavor of the soft, ripe fruits is, by some, very much liked, though others do not care for them. To me, they taste like a combination of nectarine and pineapple, with a dash of melon thrown in, and when I say that it is to most other good fruit what Stachys affinis tuberifera is to most other good vegetables, my meaning will be pretty clear.

Having read of the Salpichroa or Withamia, as a new fruiting plant last spring, I went to a good deal of trouble to get plants, but the result is not very encouraging. The plant belongs to the Solanneæ, and so is a relative of the potato, tomato, chili, etc. As to growth, the treatment usually given to tomatoes indoors suits it very well, and we find it fruits most freely when pot bound or starved a little, and the fruits set most freely in the open air, or when flies and bees obtain access to the flowers.

I send you fresh specimens showing flower and fruit, also a sketch of a flowering and a fruiting spray.

After having obtained plants from Italy, as well as from a London nursery, I was a little surprised to find that the plant had been growing in a corner of the garden for at least the last twenty years. Once or twice, indeed, it spread so much that we had tried to dig it out, but its roots and stolons spread so fast that it always reappeared. As thus rampant on a deep rich border, however, the plant runs all to stalks and leaves, and but rarely has flowers or fruits, but last year a few fruits were produced, owing doubtless to the hot season. It is just worth cultivation as a botanical curiosity, but, so far as I can see, its fruit will never become of any serious economic value.—F. W. Burbidge, in Gardeners' Chronicle.



A NEW FRUIT—SALPICHROA RHOMBOIDEA IN FLOWER AND FRUIT.

* Salpichroa rhomboidea.—Miers, in Hook. Lond. Jour. of Bot., iv., 1845, 321 (Solanaceæ).

HOW TO IDENTIFY PRECIOUS STONES.*

By LEOPOLD CLAREMONT.

THE greatest difficulty is frequently experienced by prospectors and others, who have not had opportunities of handling precious stones in the rough, to distinguish them one from another, and discriminate between gems of the greatest value and others which are comparatively worthless. It is a mistake to place any reliance whatever upon color as a test of a precious stone, as there is no property natural to gems which is so fickle and unreliable as that of color. For instance, if a stone be red, it is not of necessity a ruby, nor a white stone a diamond; and there are yellow sapphires, green diamonds, and blue spinels. In the diagnosis of precious stones it is advisable always to apply as many different tests as possible to each specimen, and to be guided by the result of them all, as it often happens that one is apt to be misled by the application of a single test.

Most of the precious stones (opal and turquois are the exceptions) are crystals of rare minerals occurring in nature in more or less familiar geometric crystalline forms, which are classified by mineralogists into six systems, the study of which comprises the science of crystallography. Although a knowledge of crystallography, or the natural forms in which crystals occur, is of the utmost value in the successful discrimination of rough precious stones, it is not a subject which can be easily mastered, or brought into practical use without considerable application and study. The reason for this is obvious, when we consider that, with the exception of diamonds and a few other gems, crystallizing in the "cubic system," precious stones are seldom found to exhibit more than a trace of their characteristic crystalline formation, which fact is due to accidents at some remote period of their existence, rough usage while immersed in rivers and torrents, etc.

The natural properties of gems which are most easily and most universally used as tests, are those of hardness and specific gravity. By the hardness of a gem is meant the power which it possesses of resisting abrasion. Many of the hardest minerals can be easily broken, fractured, or chipped, though they cannot be scratched; thus a very hard stone may be a very brittle one. Diamonds, emeralds, and zircons, for instance, have often been injured by a blow or a fall. There is a scale of hardness, devised by the mineralogist Mohs, consisting of 12 minerals, which forms a recognized standard to which specimens under examination may be compared. The scale is as follows: Diamond, 10; sapphire, 9; topaz, 8; quartz, 7; felspar, 6; apatite, 5; fluorspar, 4; calcite, 3; rock salt, 2; talc, 1. Fragments of these minerals, suitably mounted in little handles, are applied in succession to the gem to be ex-

* Abstract of article in the London Mining World.

amined, so as to attempt to scratch it. When the gem neither scratches nor is scratched by any member of the scale, the two stones may be considered of the same hardness. When it scratches the softer and is scratched by the harder of two test-stones, some idea of its position between them may be obtained by drawing all three specimens, with slight pressure, across the surface of a fine, clean, hard file, and noticing the different degrees of resistance to abrasion and the sound produced. This operation requires to be done with a delicacy of touch which is made perfect by practice alone. The following list of a few of the gems and their degrees of hardness will serve to show their relative position to Mohs' scale: Diamond, 10; sapphire, 9; ruby, 8·8; chrysoberyl, 8·5; zircon, 7·8; emerald, 7·8; green garnet, 6. It is an interesting fact, although of no importance in distinguishing precious stones, that slight variations in hardness exist between individual specimens of the same kind of gem brought from different parts of the world, and often, too, even between those obtained from various mines in the same locality. Thus the toughest diamonds come from Australia, while Indian and Brazilian stones are harder than those from the Cape.

To obtain the specific gravity of a stone, liquids of different degrees of density are used, in which the gems either float or sink according to their relative weight. A solution of mercuric iodide in potassium iodide ("Sonstadt's solution") is a liquid of great service, which should be made up to solutions of several different densities: Solution A = 3·17; solution B = 2·9; solution C = 2·67; solution D = 2·63. This fluid has, however, the disadvantage of being very poisonous and corrosive. Another suitable liquid is methylene iodide, which is easily diluted by the addition of benzine, each drop of benzine making the liquid less dense. Nothing can be easier or more satisfactory than this method; however minute the stone may be, it can be identified by its density in a few moments. Suppose it be doubtful whether a certain gem is an aquamarine or a chrysoberyl; all that is necessary is to place it in a tube of methylene iodide, together with a small fragment known to be aquamarine, to serve as an index. If it be a chrysoberyl, which has a specific gravity of 3·6, it will immediately sink; if it be an aquamarine, which has a specific gravity of 2·7, it will float, in which latter case, if the liquid be diluted and stirred until the index fragment is exactly suspended, the doubtful gem also will neither float nor sink, but will remain poised beside it. The only reason why this method has not been more generally adopted is that, unfortunately, a great number of gem stones are heavier than methylene iodide. But this objection is now removed by a discovery made by the distinguished Dutch mineralogist Retgers. He has found a colorless solid compound which melts at a temperature far below that of boiling water to a clear liquid five times as dense as water, and therefore sufficiently dense to float any known precious stone. This compound is a double nitrate of silver and thallium, and possesses the remarkable property of mixing in any desired proportion with warm water, so that by dilution the specific gravity may be easily reduced. The fused mass may be reduced in density by adding water drop by drop, so as to suspend in succession jargoon, carbuncle, sapphire, ruby, chrysoberyl, and spinel.

The optical properties of precious stones form valuable means of identifying them, especially when cut and polished; and there are several different kinds of scientific instruments of a more or less practical character which can be applied in this connection. The method of measuring the extent to which a ray of light is refracted in passing through a gem may be practiced with the goniometer, an instrument found in every physical laboratory. In order to avoid the necessity of cutting the stone into a prism, it is advisable—after finding two of the facets, which form a convenient angle—to paint over the remainder of the stone. The ray of light may then be traced through the two open facets, and in this way can be measured not only the refraction, but the double refraction of the stone. For this purpose, also, the little instrument known as the reflectometer is simple; but, unfortunately, only useful to examine gems of low refractive power, such as topaz and less brilliant gems.

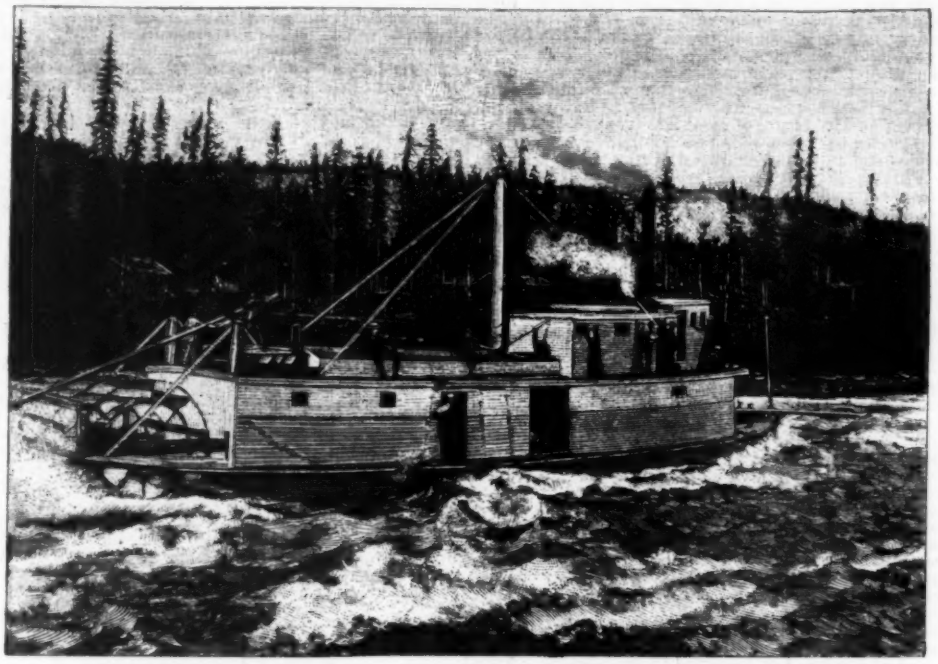
The dichroscope is an instrument which enables one to tell at a glance whether a gem be doubly refractive or not, thereby deciding at once if the specimen belongs to the cubic system of crystallography or not. This is of value in distinguishing rubies and sapphires from other somewhat similar stones, which might be mistaken for them, and this instrument is in almost universal use among gem merchants. It is not commonly known that many transparent minerals, when viewed through a spectroscope, cause characteristic black bands to appear across the spectrum. Two of these minerals happen to be the gem stones jargoon and almandine garnet, sometimes called carbuncle. When a stone, say one set in a ring, is looked at in this way and gives the characteristic spectrum of zircon, it is at once known to be jargoon, without any further trouble. A crystal of tourmaline, while being warmed, becomes electrified, one end becoming charged with positive and the other end with negative electricity. Advantage has been taken of this fact by Prof. Kundt to make a very pretty test for tourmaline.

If a mixture of powdered red lead and sulphur be blown or shaken through a sieve, the particles become electrified by mutual friction, and if it then be dusted upon a crystal of tourmaline which is being warmed, the positively electrified end of the crystal attracts the negatively electrified yellow sulphur, and the other end attracts the positively electrified red lead—thus one end of the crystal becomes red and the other yellow. Now every crystal of tourmaline behaves in this way, and no other gem stone; so that this is a practical test, as well as a very pretty experiment.

A retrospective museum of the history of chemistry is being organized to figure in the Paris Exposition of 1900. In the exhibition will be included objects relative to scientific discoveries and industrial improvements; in fact, everything which will show the progress of industries in which chemistry has a part. There will also be portraits of inventors, drawings, models in relief, etc. The industrial museums, universities, schools, etc., all over the world will contribute to the exhibition.

A NEW GOLD REGION.

CONSIDERABLE interest has been aroused by the discovery of gold deposits in British Columbia far richer than those of the Klondike region. Naturally, the accounts of the new fields were at first received with some doubt, for most prospectors had not yet recovered from the evil effects of the Klondike "boom." But from more recent and more trustworthy reports, it would seem that the richness of the region has in nowise been exaggerated. British Columbia will enter upon a career of prosperity, because there can arise no boundary disputes over these deposits, as in Klondike; because the region is more easily reached; and because the digging of gold is unaccompanied by the toil experienced in Alaska. Before we describe the region itself, we shall first tell something of its discovery.



THE STEAMER "ORA" CROSSING WHITE HORSE FALLS.

The news that in the superficial strata or "dirt," as it is called, gold had been obtained, was first received in Skagway in the beginning of August. As a result, the miners and salmon fishermen who had settled there deserted the town after a few days; the post office was the only place in Skagway where a human being could be seen. Soon policemen came to Victoria who had heard of the discovery of gold, and who confirmed the reports. Immediately the fever spread over the entire northwestern coast. The correspondent of The San Francisco Chronicle telegraphed to his paper that he had convinced himself that nothing had been exaggerated, and that the new gold fields were full of promise.

The discoverer of this new gold diggers' Mecca is a man of German descent named Fritz Miller. He lived in Juneau, not far from Skagway. While on a prospecting tour with a friend he had seen the glittering metal shining in a creek flowing into Atlin Lake. Miller left his partner on the spot and hastened to Juneau. The few intimate friends to whom he imparted the discovery readily followed him. In a layer only seven feet deep he and his companions dug up gold which yielded $60 a day for each man. Miller and his companions had arrived at the place with provisions enough, but with insufficient tools. Miller informed the Canadian authorities of the claim which he had "staked," and in this manner the discovery became known to the Canadian police. Not only had Miller discovered gold, but he had also secured for himself the richest claim.

It cannot, of course, be as yet determined how extensive these gold deposits are; but certain it is that the gold found here is more valuable and more pure than that of Klondike. The banks pay $18 an ounce for Columbian gold, while the Klondike metal is rarely worth more than $14.

Since these reports have been received, everyone has started for the new land. The mild climate and the ease with which gold can be obtained have enticed diggers in large numbers to the region. The new fields are more easily reached than those of Klondike, and the journey is not accompanied with such hardship. The route pursued is the following: From Victoria a steamer is taken to Skagway, Alaska, a voyage of about five days. From Skagway the "trail" of the Chilcoot Pass is followed for about thirty-two miles—a journey which must be made on foot, since a horse costs $20 a day and can make no better headway than a man. One of the accompanying illustrations represents an expedition of gold diggers climbing the Chilcoot Pass, which, moreover, is the preferred overland route to Klondike. At Bennet's Lake the digger must take passage upon a little, 250-ton, stern-wheel steamer, in order to reach the head of Tagish Lake, forty miles distant, and to proceed up the Taknan River to the Altina River, which flows into Atlin Lake. After having crossed the lake, Pine Creek is reached, the center of the Cassiar district gold region. The entire distance from Skagway is 180

STEAMING UP MILES CAÑON.

miles, and from the head of Tagish Lake to Pine Creek 107 miles.

The journey to the new gold region costs less than that to Klondike, is not so dangerous, and, above all, is more profitable. The city of Victoria, the capital of British Columbia, it should be mentioned, is situated on Vancouver's Island and is not to be mistaken for the city of Vancouver on the continent.—Illustrirte Zeitung.

THE TECHNICAL SCHOOLS OF GERMANY.

THE basis of the British grievance against Germany lies in the enormous commercial strides that have been made by the latter country. Within the last twenty years German traffic with other countries has increased 124 per cent., and with the British colonies of East India, South Africa, and Australia has multiplied 500 per cent. "Made in Germany" is the inscription on packages in foreign ports that is now more frequently met with than "Made in Great Britain." German cottons are sold in Manchester, German silks in Spitalfields, and German steel in Sheffield and Leeds. The insidious hand of the Teuton is in the pocket of the Englishman. The reason for this reversal of trade conditions has only recently been made apparent by reports made to the Duke of Devonshire by a parliamentary committee, and to the Manchester technical instruction committee that had in charge the proposed equipment of a textile school. In these reports the importance and the public support given to technical and trade schools in Germany were held to be a large factor in the growing commercial strength of that country.

The gist of these reports is of quite as much importance to the United States, whose rivalship of Great Britain, in certain fields of manufacture, is beginning to be recognized. Our advantage consists in the abundance of raw material and fuel at hand, and in the superiority of our machinery.

From the record made by Germany it seems we must also add special training, when our position would be superior to any country in the world in the amount of goods made, the quality, and cheapness of production. Several technical and a few trade schools have been established by private endowment, but cannot yet be said to be accepted by the public as necessary to the system of education. Mr. Theodore C. Search, president of the National Association of Manufacturers, said recently that we are under the impression that we are the best educated people in the world, the refutation of which claim lies in the fact that we hold learning cheaply; that is the "self-made" man is considered to have a better chance in life than the one with university training. In the conduct of our national business we have contempt for historic and economic knowledge, trusting entirely to the inspiration of politicians. Nothing kills a man so quickly with us as a reputation for having theories, yet the discovery of our country, the declaration of independence, and every invention that has helped make this age of machinery, was based on theories. The feeling here is characteristic of the self-confidence of youth.

GERMAN RESPECT FOR SCHOLARSHIP.

In Germany, on the contrary, there is and has been, since Napoleon and Goethe, a vast respect for learning, and a disposition to expand rather than to contract the meaning of the term. Nowhere else in the world has so great honor been paid to men of pure learning nor so many facilities offered to the pursuit of investigations in the sciences. It is practically impossible, by the offer of greater pay, for instance, to induce a celebrated German professor to leave the fatherland, for he goes to a less sympathetic and inspiring public. Education in Germany is the main business of a boy's life from the age of four or five, when he enters the kindergarten, for at least twenty years. It may have its appropriate end in the university, military, scientific, commercial, or technical school, but it has a definite end, and the boy is trained from early youth to do one thing well and to do it understandingly, so that he can adapt himself to changed conditions. In the United States and England the practice is to let a boy learn his business or trade in the office, shop, or mill, and the employer must very largely bear the burden of this unprofitable apprenticeship. In Germany the manufacturer has nothing but skilled labor to pay for, and it is to be noted that Germany is making strides commercially in those manufactures in which superior knowledge, technical skill, and the agency of the expert in chemistry and other sciences can be brought to bear.

The industrial development of Germany began more than a half century ago, when that country first felt the effects of British machinery that was superior to their own, and the lack of railroads to remote factory districts. These serious disadvantages were offset, to a degree, by the severe apprenticeships required to learn a trade, which turned out a superior class of workmen. At the close of the Franco-Prussian war, in 1871, states and municipalities first displayed a determination to increase the number and extend the scope of the public schools. Large numbers were equipped for manual training, some going so far as to teach the specific trades relating to wood and iron working. Drawing was universally taught, both mechanical and free hand, supplemented by color work. The direct result of this latter is to be seen in the marvelous results in printing and lithographing, Germany now supplying the world with the cheaper forms of art. The public schools may be said to have given the boy a chance to find out how he would like to make a living. When he had found out, there was the higher school to develop his special talent.

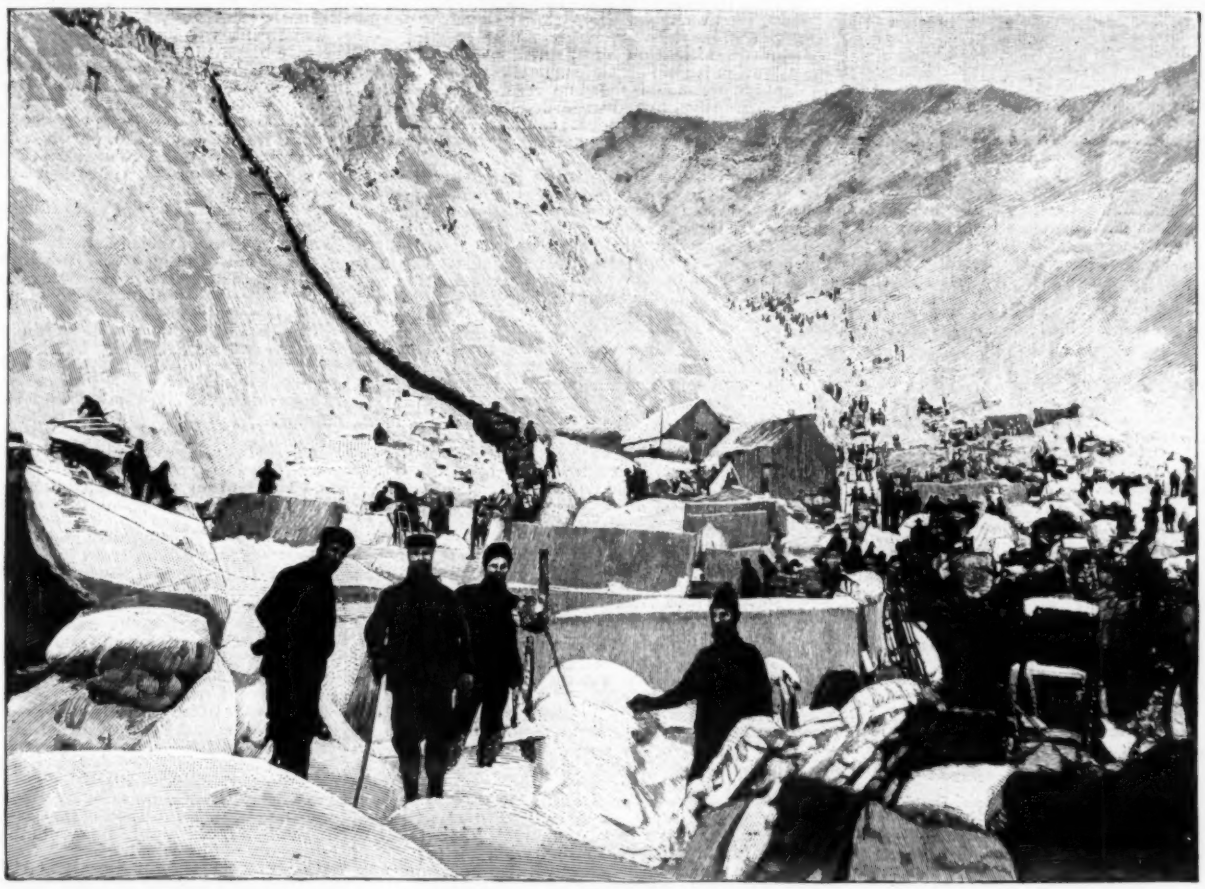
ORIGIN OF THE TRADE SCHOOL.

The introduction of the trade school was not so much of an innovation as might be supposed, but was directly in the line of German methods of development followed for hundreds of years before the learned colleges were open to the common people. These not being able to obtain a classic education, took all the greater pride in the particular trades to which they were born. The guilds of Nuremberg and Augsburg were jealous of their crafts, and permitted the admission of none but those who could pass the severest examination after long and arduous apprenticeships. The Germans did not fall into the error of carelessness with the introduction of machinery. Two hundred years ago Andrew Yarranton, who introduced the tin plate industry into England, from Saxony, wrote a pamphlet entitled "How to Beat the Dutch Without Fighting," advising the importation of German workmen and German systems of apprenticeship. Indeed, the phrase "beats the Dutch" signified that a thing was a superior specimen of its kind. For the better part of a century England beat the Dutch in manufactures and commerce. Now the question is restored, and the old point raised of how to beat them without fighting. One of the ways employed is the recent erection of a textile school at Manchester similar to that at Crefeld, Germany.

In the trade and technical schools that were built in the latter country a quarter of a century ago vast sums of money were spent, but so rapidly have the times changed that the buildings are even now being torn down and replaced by establishments that are equal to the demands of new conditions. These schools are supplemented by permanent industrial museums and libraries of statistics. Greater importance than ever is attached to higher scientific training, the demand for which increases as the facilities are enlarged. At Nuremberg an entirely new building is now in course of erection for the industrial art school, at a cost of $200,000. Special instruction is to be given in the applications of art to wood carving, metal work, lithographing, and general decoration. The Gewerbe Museum, of the same city, also has a handsome new edifice where courses of popular lectures are given similar in character to those given at the Conservatoire des Arts et Metiers at Paris, on all new inventions likely to prove useful for trade purposes and in the development of science and art processes. In the laboratories a staff of professors and their assistants are employed in chemical research, and students who wish to conduct experiments in chemistry for manufacturing processes receive gratuitous instruction and assistance. A special feature of the trade museum is a collection of specifications of patents, and histories of all the factories in Bavaria, with descriptions of their equipment. At Stuttgart a similar museum was opened last year, at a cost of $1,000,000. It is somewhat on the order of the South Kensington Museum.

LARGE ATTENDANCE AT TRADE SCHOOLS.

In this latter city an entirely new group of buildings has been added to the technical high school, to be devoted to chemistry and electro-technology. At Darmstadt, a town of less than 60,000 people, the polytechnic high school has recently been rebuilt at a cost of $500,000, and it must be remembered that the cost of buildings in Germany is much less than in this country.



CHILCOOT PASS—THE LAST STRETCH.

These instances may be taken as examples of the steady advance made by Germany in the further provision of facilities for higher scientific training as a means of developing the industries. The attendance at these scientific schools is larger than at the universities, that at Charlottenburg, Berlin, alone having 3,000 students enrolled. Electrical laboratories are more numerous and more completely equipped than in any other countries of the world. It is said that there are no school laboratories in England or the United States which can compare with those of Darmstadt and Stuttgart, and that no facilities exist in English speaking countries for original and independent search in physics equal to those afforded at the Imperial Physical Institute at Charlottenburg. As an example of the different attitudes of the two peoples, Prof. Dewar was able to produce liquid air only by private contributions, while Roentgen and Behring had public support in the carrying on of their researches.

To fit for commercial life the training is just as thorough. Instruction and discipline in the primary schools are more severe, and are more heartily supported by the people. The teaching of modern languages is insisted upon in the secondary schools, with results of the greatest possible benefit to the German clerk and commercial agent. The habit of accuracy, punctuality, attention to detail, and strict obedience is all the time impressed on the pupil. Then he is taught that few people strike bonanzas in this life, and that thoroughness in understanding and devotion to a business are the qualities that win. Large numbers of young Germans are sent into England, France, and the United States to take clerkships in manufacturing and exporting houses. They speak and write German, English, French, and often Spanish, and thus become valuable employes. They learn the merchant's customers, prices, methods of packing, shipping routes, and charges, all of which knowledge they take back to

Germany and use for their own preferment and to the benefit of the home trade. The experience is considered justly a part of their education. In his latest novel, "Katherine Regina," Sir Walter Besant has a type of the young German clerk in London as one of his characters. He is more competent, reliable, industrious, and indispensable than his fellow clerks, and is content with a smaller salary—until he is ready to go home. With such insidious competition the Briton is finding it difficult to contend.

THE GREAT TEXTILE SCHOOL AT CREFELD.

As regards distinctively trade schools, these are more numerous in South Germany than in Prussia. A good example is the textile school at Crefeld, a town that is the Lowell and Manchester of Germany. Lowell opened a textile school just one year ago, while Manchester, England, has one under construction. The school at Crefeld was erected fifteen years ago at an original cost of $200,000, and a $60,000 additional building was put up a few years since. Besides the departments for spinning, weaving, dyeing, and finishing, there is a museum which is said to contain the finest collection of textile samples and patterns in the world, and designers from distant factories visit it daily for the purpose of draughting. As the result of an exhibition of Turkey carpet patterns at this school a factory for making Smyrna rugs has been started in the city, the first rival to the Bromleys, of England, in the production of this line of goods.

The library and reading rooms contain all the important textile books printed in every language. In the spacious quadrangle the large weaving room contains ninety different kinds of power looms run by electric motors, besides forty-four hand looms for the weaving of certain rare fabrics. The laboratories for the analysis of colors and for private research are extensive, and the dyeing school is as complete as the most modern dyehouse of a factory. The school is practically the center of inspiration for manufacturers of the district. The greater part of the silk trade of Germany, which amounts to over $40,000,000 annually, comes to Crefeld, where, because of the school, it was found that in times of depression in the silk trade it was possible to initiate new textile industries to occupy the machinery and employ the workmen.

The dyeing department of this school is intrusted with the dyeing of the yarns used in the Royal Gobelin factories, of Berlin. Researches and experiments for outside parties are constantly being made by the students under the direction of the teachers, thus giving them a foretaste of the difficulties they will have to overcome when they enter commercial factories. Many of these investigations are made for local manufacturers who wish to reproduce the special tints of goods received from abroad. When a new loom comes into the market, it is immediately purchased. The teaching staff is twenty-two for five times as many pupils. At the Aix-la-Chapelle School, which is devoted to worsted and woolen spinning and weaving, the arrangements are equally elaborate; indeed, the school is, with some obvious limitations, a woolen factory, about sixty pieces of cloth being turned out each week. At Berlin there is a municipal higher weaving school for the education of managers, and here the sons of manufacturers are sent.

The "Gewerbe" or trade museums are important adjuncts to the school system. That at Nuremberg will give a good idea of their scope. There are eighteen different divisions, the first of which relates to applied art. There is a collection of patterns or samples which consists of 10,000 specimens of ancient and modern examples of work in wood, metal, glass, clay, leather, and paper, also woven fabrics, embroideries, and laces. In the second division are 60,000 sheets of illustrations of art industries of all nations and periods, classified and mounted under glasses in cases for easy reference. These may be copied. The library and reading room has 13,000 volumes of art, industrial and technical works, with 136 periodicals, foreign directories, trade catalogues and address books. All these rooms are open to the public.

INFORMATION ABOUT PATENTS.

The mechanical and technical division has departments for giving information on patents and trade marks, and patents may here be applied for and trade marks registered. Information is also given as to the machines, tools, raw products, and manufactured goods of all the world. Literary advice is given, course of study outlined, and technical questions answered. In the experimental department gas, benzine, and petroleum motors are arranged for trial tests, as are also steam engines, air compressors, water wheels, turbines, electric motors, and all labor-saving machinery. For these tests a fixed charge is made. The chemical laboratory occupies itself with investigations relative to technical and industrial chemistry and conducts researches.

We have nothing in this country that can be compared with the Gewerbe exhibitions that are given every few years in the large manufacturing towns. The one held in Stuttgart in 1896 is typical. It consisted of an artistic industrial section and an electro-technical section, the latter occupying the most space—for electricity and its application to the industries is receiving an enthusiastic reception in Germany. No less than 400 exhibitors took part in the electro-technical section, not only filling the Gewerbehalle and a temporary annex for machinery, but also occupying a specially constructed house in which every possible process connected with the domestic applications of electricity was shown in operation. A so-called "Gewerbedorf" or industrial village adjoined the main building, and comprised all kinds of small industries in which electricity was called into play, these applications being shown in action. The village had the appearance of a mediæval German town, and recalled the past industrial activity of Germany. It might have been old Nuremberg, to which Hans Sachs, the Reformation cobbler-poet, returned at the close of his wanderings, to his bench, his wife, his apprentices, his guild and meistersingers. One of the buildings was a fac-simile of the birthplace of Schiller at Marbach.

In this "Gewerbedorf" electricity was applied to cooking bread and candy making, type casting, and press work. Liquid carbonic acid gas was used as a motive power for beer engines and pumps. Electroplating, electrogravure, and photogravure were done, and there was a special chamber devoted to the Roentgen ray apparatus. The exhibition, at its close, was made the occasion of opening the new Landes Gewerbe as a permanent museum.

As regards the facilities for the education of the common artisan in Germany, evening schools are provided in every industrial village. Employers often arrange to give apprentices two afternoons a week to attend technical classes. The teaching is largely supplementary to shop practice, and care is taken to specialize the instruction in drawing to suit the trade followed. Pupils are compelled to remain in the public schools until fourteen, and are thus better prepared for receiving instruction than in places where primary education is not compulsory. Many have had four years in the secondary schools. As a direct result of this, the wages in all skilled industries in Germany are said to be rising; a certain degree of proficiency in school wins release from military service, and emigration is falling off. Child labor has practically disappeared. Everywhere in Germany there is evidence of activity, factories are going up, new processes are being invented, new schools erected. The people have the air of just having discovered that they are among the winners of the world's prizes, and are straining to reach the goal. The means by which they have been able to go so far in the race and overcome the obvious advantages of England are well worth considering.—Modern Machinery.

METHODS OF PREPARING RUBBER.

By R. H. BIFFEN.

So much has been written within the last few years on the subject of India rubber, the sources of our supply, and the possibility of acclimatizing the best yielding trees in our colonies, that at first sight it may appear that there is little more to be said. A study of the methods in use for preparing rubber from the latex, or milk, may, however, be of use to many interested in the formation of plantations, especially if some attention is paid at the same time to the inaccurate statements made in some recent publications, which apparently have disregarded the valuable series of papers on the subject contained in our one journal devoted to economic botany, "The Kew Bulletin."

The methods in use at present are either the outcome of the limited experience of uncivilized peoples or the application of experiments made without paying due attention to what is known of the chemical constitution and physical properties of latex. As a good example of the latter we may take the experiments of Morisse,[1] who found that coagulation was brought about in the latex of Hevea by the addition of alcohol, phenol, hydrochloric acid, nitric acid, sulphuric acid, calcium chloride, ferric chloride, corrosive sublimate, etc. As the outcome of these experiments, a mixture of phenol in alcoholic solution and dilute sulphuric acid was recommended as a coagulating agent.

The latex is, as a general rule, a thick, white fluid, composed of small particles of rubber in suspension in a clear watery solution of various substances. Unfortunately, only the latex of a few trees has, as yet, been chemically examined when fresh.

The analysis of the latex of Hevea brasiliensis shows that it contains:

Rubber	32	per cent.
Proteid matter	2·3	"
Calcium and sodium salts	9·7	"
Resin	traces.	
Water	55 to 56	"

It is slightly alkaline to litmus paper.[2]

The presence of albumen, globulin, and other proteids, has been demonstrated by Green[3] in some other rubber-yielding latices.

As a general rule all these substances are to be found in rubber as it is at present prepared, often with others added to bring about coagulation of the latex, and accidentally or intentionally added impurities such as bark and clay. In all cases the percentage of impurities is large, how large we shall see later, and when it is remembered that some cause a rapid deterioration of the rubber, it is obviously much to the interest of those connected with the industry that a method of preparation should be adopted which would minimize them or insure their absence.

I propose now to consider a few of the better-known varieties of rubber.

Pará rubber is the product of Hevea brasiliensis, a tree which thrives in many parts of the Amazon valley, British Guiana, etc. As pointed out by Churchill[4] in his consular report, there is no danger of this source of supply becoming exhausted, though this is the frequent cry of companies formed for rubber planting, usually fated for an ephemeral existence. The tapping is done with considerable care by the natives, and even should a district become exhausted, in a few years a fresh supply of trees springs up. From the planters' point of view, Brazil is hardly a suitable country, for the climate is bad, it is difficult to obtain labor, and the exchange is liable to endless variations. The trees have, however, been introduced into Ceylon, where small plantations exist, and into other colonies.[5]

The method of preparing the rubber has been so frequently described that repetition is needless; but a "translation of a valuable article on rubber of the Orinoco"[6] has received so much attention of late that it requires some examination. One of its most striking errors is the following:

"As the juice contains a considerable quantity of water, the preparation of rubber consists essentially in separating the former from the latter, which is performed by evaporating the water by means of a heating process or obtaining its coagulation by certain chemical processes. Although the last system is more rapid, they prefer the former, as they pretend that the rubber thus obtained is of a superior quality—a supposition devoid of all reason."

As I have already had occasion to show,[1] this statement is incorrect, for the heating continues for too short a time ("the rubber" is not "dried in a few minutes") to evaporate off some 50 per cent. of water, and further there is no loss of weight until the clot begins to contract and squeeze out water. Neither is "the supposition devoid of all reason," for it is a well known fact that the smoked rubber is far preferable to that obtained by chemical processes. A comparison of the prices of "Pará fine" and "sernamby" should be sufficient proof of this. Why it is so may be made clearer from the following experiment. At the end of a day's work I had several liters of latex left, to which an equal volume of water had been added, which would not keep overnight without coagulating. To this a small quantity of acetic acid was added, and in a short time the whole of it had formed a stiff curd. On pressing and drying, a portion of the water exuded from this mass of sernamby, but it still remained full of cavities, and the proteid matter in it quickly decomposed, so that ultimately a stinking, inflated mass was obtained.

If this latex had been coagulated by smoking, it would have yielded a wet rubber, but the subsequent decomposition of proteids would not have set in, for the creosote contained in the smoke would have acted as an antiseptic and prevented decomposition, as it does when meat is preserved by smoking.

Then again we find, "the rubber thus prepared (by smoking) acquires a darkish color, due to the particles of coal which adhere to the outer skin. Some people believe that this tends to improve it, but such is not the case, for it is thus impregnated with impurity."[2] Now when these "bottles" of rubber are cut across, the fresh, laminated surfaces are a silvery gray color, and as each layer is exposed to the same extent to the action of the smoke, it is difficult to account for the outer layers only being so colored.

The freshly cut surfaces, however, soon darken and become black in turn, so that the explanation of oxidation seems far more probable, especially when taken in conjunction with the fact that the smoke is white[3] and not black,[4] for the nuts are simply dry-distilled and not actually burnt. If the smoke of these heated urucuri nuts is condensed, it forms two layers of liquid in the receiver, one a clear limpid solution consisting mainly of acetic acid, the other, darker in color, of creosote.

The hot vapor of acetic acid brings about the coagulation of the proteids of the latex, as may easily be proved by direct experiment.

A solution of alum is said to be in use for preparing rubber in some parts of the Amazon valley. Morisse[5] states that alum solution has no effect upon the latex of Hevea species, however.

The loss in the factories on making up Pará rubber is as follows:[6]

1, Pará fine, 10 to 15 per cent.; 2, entre-fine, the carelessly smoked pieces, 15 to 20 per cent.; 3, sernamby, rubber pulled from the cuts on the tree and cups, coagulated by being allowed to stand, etc., 20 to 40 per cent.

From these data we may safely conclude that the smoking method of preparation is by far the best in use at present—a view which will be further strengthened when we compare the losses on making up other sorts of rubber.

Ceará rubber is the product of Manihot Glaziovii, a tree growing chiefly in the highlands of the state of Ceará, Brazil. Cross is responsible for most of the descriptions of the locality in which it grows, but as his experience of it appears to have been limited to Pacatuba, in which place its habitat is far from typical, they are not very accurate. He records it as growing at an elevation of 200 feet above sea level, among granite bowlders, in a country whose dryness was indicated by the fact that "ferns, weeds, grasses, and mosses" were absent. True, it does grow among granite bowlders, in the scantiest of soil in such localities, but it is more at home in the mountains, up to a height of 3,500 feet, and even more, where there is an abundant rainfall. These facts will serve to show the wide range of conditions the tree will put up with, and were it not for the smallness of its yield (1 to 3 lb. per annum), it would be invaluable for introducing into many of our colonies.

Coagulation is brought about either by smoking, as on the Amazons, or by simply allowing the latex to dry on the tree trunks or soil. The latter methods are objectionable, as the rubber invariably contains pieces of bark or grit. It may also be prepared by churning the latex, and pressing the resulting clots. The method is not to be recommended, though; for, even if the clots are cut into thin slices and exposed to the heavy pressure of a mandioca press, a considerable percentage of water remains in its cavities, and decomposition sets in, but not to the same extent as in "Ceará scrap."

Although so impure it commands a price usually second only to "Pará fine." The loss is from 20 to 25 per cent., which, in inferior qualities, may even amount to 55 per cent.

Mangabeira rubber also comes from Ceará. It is the product of Hancornia speciosa, a dwarf tree with somewhat the habit of a birch. The rubber is prepared by the addition of an excess of salt to the latex, or by Strauss' method of adding alum. Even after thirty days' drying in the sun it is spongy and full of cavities of liquid. As might be expected, the loss on purification is enormous, amounting to from 40 to 60 per cent.

By this method of coagulating with chemical reagents it is impossible to get rid of the coagulated proteid matter, to say nothing of the greater part of the water. Morellet's[7] remark that "le procédé Strauss est ingénieux, mais les résultats de son application sont mauvais" may well be applied to all these chemical methods, and the sooner the search for coagulating agents is abandoned, the better.

The only other American rubber of importance, at present, is yielded by Castilloa elastica. It appears on

[1] Seeligman, Lamy, et Falconnet; "Le Caoutchouc et la Guttapercha," Paris, 1896. P. 68.
[2] "Le Caoutchouc," etc., p. 94.
[3] Green, "Proc. Roy. Soc.," 1886, p. 28.
[4] "Kew Bulletin," 1896, p. 241.
[5] "Kew Bulletin," 1893, p. 159.
[6] "Trinidad Bulletin," 1898, No. 18, and 1897, p. 36.

[1] Biffen, "Anns. Bot.," 1898, p. 165.
[2] "Trinidad Bulletin," 1897, p. 38.
[3] Compare the plate on page 757 of the "Jour. Soc. Arts," 1898.
[4] "Trinidad Bulletin," 1897, p. 37.
[5] "Le Caoutchouc," etc., p. 67.
[6] "Le Caoutchouc," etc., p. 75.
[7] "Le Caoutchouc," etc., p. 64.

the market in a number of different forms under the names of Mexican, Nicaraguan, etc. As far as we know, *C. elastica* is the only species of the genus yielding rubber, for the C. Markhamia, of Collins, turns out to be a Perebea species.[1]

The latex is obtained in a rough and ready fashion by hacking a spiral channel from the crown of the tree to the ground, or by making great gashes with a machete.

Collins[2] has recommended a timber-scoring knife for tapping, and since then most writers have followed his lead. On experimenting with one, I found it was practically useless, as little latex exuded, possibly owing to the closure of the vessels by the drag of its edge. Stabbing with a broad-bladed knife, or with a chisel, as practiced in Ceylon,[3] gives good results without much damage to the tree. In the previously mentioned article in "The Trinidad Bulletin" (1898) there is some slight confusion as to the localities suitable for the growth of Castilloa. In one place (p. 122), "it will scarcely thrive in regions that are not equally suited to Hevea spp," which (p. 130) grow "on land which is periodically inundated, even to a depth of five feet." Then (p. 121), "the tree (Castilloa) avoids marshy or boggy land, and manifests a preference for warm, deep loam, or sandy soil." The latter statement is the correct one.

The most general method of preparation in Mexico is to add an extract of the leaves and stem of the moon flower (Ipomoea bona-nox), and allow the mixture to stand overnight. The floating clot which forms is then pressed to remove some of the water.[4] As in all these cases of preparation by "wet" methods the rubber contains large quantities of water, it loses from 12 to 30 per cent. on drying. Another method is in use in Nicaragua.[5] The latex is mixed with about three parts of water, and allowed to stand overnight, when the rubber comes to the surface in particles, which do not unite to form a solid mass. The water is then drained off from below, and the rubber particles are mixed with a fresh supply of water, and the process is again repeated. The particles are then brought into a solid mass by pressure. The latest account of this method is apparently given by Hart, in an article on the "Coagulation of Rubber,"[6] who appears to have rediscovered it. I quote it in full, as I may be mistaken:

"After the addition of water, the mixture is well shaken; the globules of rubber (having a lighter specific gravity than the albuminoids and proteids [sic] contained in the latex) will float quickly to the surface. It is found, moreover, that on the addition of further volumes of water and the removal of albuminoid liquors from below the floating rubber, the globules rise much more quickly to the surface."

The following criticism of this "creaming" process is given in "Le Caoutchouc et la Gutta Percha:"

"Ce mode de préparation est bien rudimentaire et ne peut fournir qu'un produit de qualité inférieure, qui perd souvent plus de 50 per cent., surtout lorsqu'il fraichement préparé."[7]

Recently there has been some talk of extracting rubber from leaves and twigs by means of solvents, as has been done in the case of gutta percha. A description of this latter process may therefore be of interest. It originated in the smallness of the yield of the Isonandra gutta trees, a tree from twenty-five to thirty years old only giving 1·3 lb. of gutta percha when felled. The explanation of this fact is found in the work of De Bary,[8] who showed that the laticiferous system of the tree consisted of short, closed sacs. This being the case, a great many would remain unopened, and thus a considerable percentage of the gutta percha would remain in the bark. As the demand for gutta percha has been large, and the supply has been obtained by felling the trees, they have become almost extinct.[9]

Serullas proposes to utilize the leaves and twigs of the shoots from the old butts to extract the gum from. They are dried, treated with caustic potash to destroy coloring matters, and treated with a solvent for gutta percha. The solvent is then distilled off and may be used again and again.

Rather more than 1 lb. of gutta percha is said to be yielded by 30 lb. of chopped up fresh leaves and twigs.[10]

For several reasons I do not think this process could profitably be applied to the preparation of rubber. The most important of these are, 1, on gathering the leaves and twigs there would be an immense loss of latex; and, 2, stripping trees of their foliage (the part which builds up their food supply) invariably kills them.

The direction in which research work should tend, I venture to think, is to prepare rubber free from the other constituents of latex, so that among other things, freight and customs charges on these impurities may be avoided.

Now it has been shown conclusively that the chemical constitution of latex varies with its source, so that it is improbable that any one reagent can be found capable of coagulating any given latex. Thus from the fact that acetic acid coagulates the latex of certain Hevea species, it cannot be argued that it will coagulate the latex of a Kicksia species.

Then expert opinions, as we have seen, show that the preparation of rubber by these chemical means is not satisfactory, for the product is far from pure.

I have recently succeeded, however, in preparing pure rubber by a physical process, and so demonstrated that chemical methods are not necessary. This is effected by centrifugalizing the latex in a special form of separating machine, when the rubber particles, which have a smaller specific gravity than the medium in which they are suspended, are thrown out of the bowl in an almost dry state. They may then be converted into a solid mass by slight pressure, or by draining off the small quantity of water which remains with a porous tile. So prepared, the rubber forms a translucent mass, free from its usual smell and from all danger of decomposition.

The merits and demerits of this mode of preparation must rest entirely with me, but I cannot be responsible for any statements made in Trinidad, where a copy of my experimental machine was recently exhibited without my consent or knowledge.—Journal of the Society of Arts.

[1] "Kew Bulletin," 1897, p. 13, c. f. "Trinidad Bulletin," 1898, p. 21.
[2] Collins, "Report on Caoutchouc."
[3] "Royal Botanical Gardens, Ceylon," 1898; Ser. I., No. 4, p. 30.
[4] Belt, "Naturalist in Nicaragua," p. 33. Morris, "Colony of British Honduras," p. 76.
[5] "Le Caoutchouc," etc., p. 62. "Kew Bulletin," 1887, xxviii., p. 16.
[6] "Trinidad Bulletin," 1898, p. 131.
[7] "Le Caoutchouc," etc., p. 62.
[8] "Comp. Anat. Phan. and Ferns," p. 151.
[9] Serullas, "Kew Bulletin," 1891, ccxiii., p. 230.
[10] "Kew Bulletin," ccxiv., p. 231.

DEVELOPMENT OF NEGATIVES IN THE OPEN AIR.

OF all photographic operations, the development of the negative is the one that holds the most surprise in store for the operator. It is only at this moment that he knows whether the image is well defined, whether the light is harmonious, whether the time of exposure has been proper, and, finally, whether he has succeeded. So, when it is a question of a portrait in his studio or of a group in his garden, he takes care to do his developing at once in order to see whether it will be necessary to repeat his operations. But all this cannot be done in the country; and yet where it concerns a subject that the operator may not have an opportunity to meet with afterward, he may be glad to know whether his work has proved a success. At the time, now remote, in which gelatino-bromide was unknown and wet collodion employed, and it was necessary to do the developing immediately, M. Bourdin, a well known engineer, devised an apparatus that permitted of performing all the operations upon the spot and without a laboratory. Since gelatino-bromide plates have come into use there have been devised several apparatus that permit of developing and fixing without a laboratory, and not long ago we had an opportunity of examining a few new ones that deserve to be made known.

In the system devised by M. Ernie it is necessary, for the exposure of the plates in the camera, to have special frames that open at the bottom in order to allow the plate to pass into the developing apparatus. The latter consists of a square box (Fig. 1) surmounted at one of its corners by an inclined tube, *F*, to which one applies the eye in order to look into the interior. The opposite side carries a red glass which is covered or uncovered by means of a shutter, *H*, connected with the vision tube, *F*, by means of a chain. In the interior there is a metal frame, *P*, supported by two buttons, *U*, that are maneuvered from the outside. The slots in which these handles slide, without allowing the light to pass, permit of raising or lowering the frame and of inclining it in all directions. The tray, *R*, containing the developing bath is situated beneath.

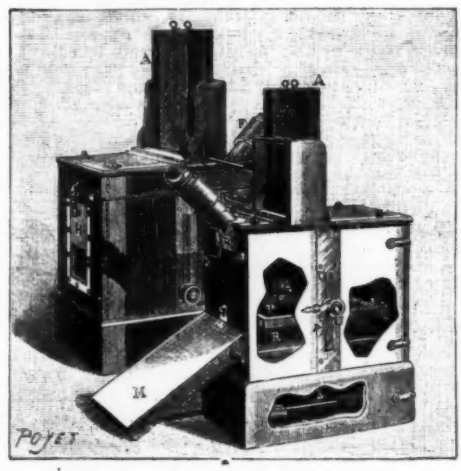


FIG. 1.—THE ERNIE APPARATUS.

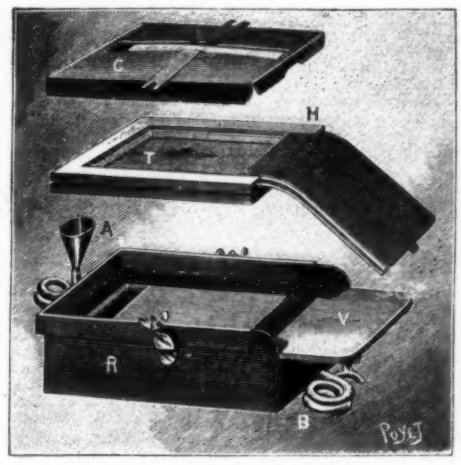


FIG. 2.—THE CANNIER & LAFITTE APPARATUS.

At the upper part of the box there is a support in which is placed the frame, *A*, containing the plate that has just been exposed. A groove formed at this place allows the plate to pass when the slide that closes the frame is pulled. Care is taken beforehand to maneuver the buttons, *U*, in such a way as to bring the frame, *P*, vertically under this groove. The frame, therefore, receives the plate and permits of immersing it in the developer and of raising it from time to time, in inclining it in such a way that it shall be interposed between the eye placed at *F* and the red glass, so as to permit of watching the appearance of the image. When it is judged that the development is complete, the frame, *P*, is made to pivot and is so inclined as to cause the plate to slide into a frame, *M*, placed in front of an aperture arranged for this purpose and which is opened at the proper moment. This frame having afterward been removed and placed before another groove, the plate is allowed to slide into the tray, *S*, which contains hyposulphite. The trays are introduced through a special door that gives access to the interior of the apparatus.

All this is somewhat complicated, but, upon the whole, is capable of giving good results after a person has made himself familiar with the various manipulations.

MM. Cannier and Lafitte's device appears to us more simple. It consists of a tight receptacle, *R*, transparent upon two sides, into which may be introduced and from which may be removed, in succession, the different liquids necessary, by means of two tubes, *A*, *B*, arranged at each extremity, and twisted spirally so as to arrest the light. The top of this receptacle is provided with a velvet-covered ledge for the reception of the frame, *A*, of the camera. This frame is provided with clamps, *T*, connected with a screw that may be maneuvered from the exterior in order to liberate the plate at the desired moment. After the frame has been placed upon the receptacle, *R* (which contains the developer), it is fastened down by means of the piece, *C*, which engages with bolts placed at the sides. Then the shutter of the frame is opened, and after the plate has been freed, the shutter, *V*, of red glass, is pulled out. The plate then falls into the receptacle, which is provided with supports in order to prevent the gelatine from touching the bottom. Finally, the red glass is put in place and the frame removed. The development is watched by transparency, and when it is judged sufficient, the bath is allowed to flow out by opening the cock of the tube, *B*. Pure water is made to circulate for an instant, then hyposulphite is poured in, and, finally, after the plate is fixed, it suffices to open the shutter, *V*, in order to remove the plate.

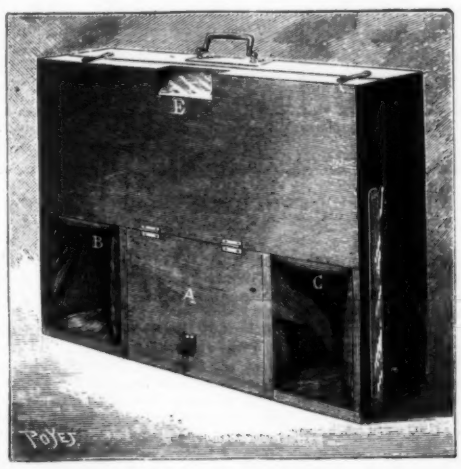


FIG. 3.—THE DONNY APPARATUS, CLOSED.

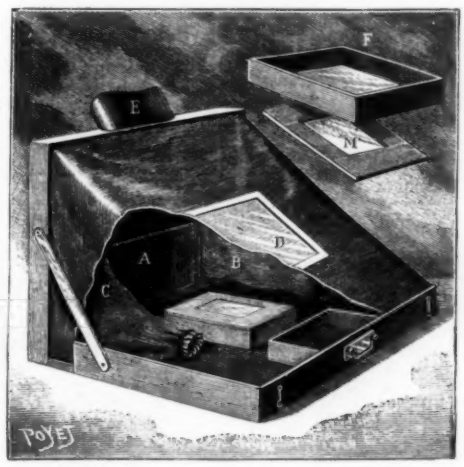


FIG. 4.—THE DONNY APPARATUS, OPEN.

All this is done somewhat rapidly, and the apparatus occupies but little space. Care must be taken, however, to arrange the frame of the apparatus in a special manner as regards the clamps that hold the plate.

The method of development devised by M. Paul Donny is very practical, because it is simple and applicable to all apparatus without any modification of the frames. In the cover of a box, *A* (seen open and closed in Figs. 3 and 4), are formed two apertures, *B* and *C*, provided with sleeves of black cloth into which one may insert his arms. The same cloth, thoroughly impervious to the light, forms a bellows and unites the cover and the box when the latter is open. In the center is fixed a red glass and in the upper edge of the cover is formed an aperture, *E*, provided with a shade for the eyes. In order to develop a plate, the box is opened, and through the door, *A*, are introduced the frames, the hand apparatus, the trays, and the solutions. Then the arms, having been in-

serted into the sleeves, one has every facility for discharging the frame and putting the plate into the developing tray. This latter has a glass bottom, and, in order to observe the image by transparency, it suffices to use the mirror, *M*, which serves also as a cover, and which is placed underneath, so that the light coming from *D* shall be reflected at *E* to the eye of the observer.

The washing and fixing present really no difficulty. It will be remarked that the apparatus serves at the same time for recharging the frames.

Generally speaking, we do not think that it is indispensable to develop in the open air; but there are certainly cases in which it will prove very useful, and it is assuredly the best method that we have of forming an opinion as to the time of exposure.

For the above particulars and the accompanying illustrations we are indebted to La Nature.

GALVANIC DEPOSITS ON NON-CONDUCTORS.

THE following is an abstract from Mr. Carl Hering's digest of an article by Knothe, in Elektrotechnischer Anzeiger, on the best process for coating objects that are non-conductors: It is hopeless to try and form a metallic coating by chemical means, and the only satisfactory methods are to use graphite or a coating obtained by a solution of silver. The graphite method is briefly described, but is considered inferior to the silver solution method. For the latter a solution of nitrate of silver in alcohol is used, the body being dipped into it or coated with it; it is then placed in the vapor of phosphor or sulphide of hydrogen, which converts the coating into a conductor. The sulphur method is preferred because the coating adheres better and the process may be repeated if not successful at first, while that is not the case when phosphorus is used. The silver solution should be made neutral with ammonia, as it will then adhere better to greasy surfaces and hastens the sulphiding process. With such a coating the first deposit is formed a little more rapidly than with graphite. The object should have one or more copper conductors attached to it to start the deposit; these starting points are best placed in the deeper portions of the object. The object should first be treated so that all pores are filled and that it becomes waterproof. This is done with wax, tallow, or a mixture of the two and collodion; wood is best boiled in linseed oil. The silver solution is made of two parts by weight of silver nitrate, four parts water, five parts ammonia of 0·9 specific gravity, and six parts of absolute alcohol. When the ammonia is added a brown precipitate is first formed, but is redissolved. After being coated with this it should be completely dried and freely exposed to the air for some time; it is then subjected to the action of the hydrogen sulphide. This process may be repeated as often as necessary. The current for depositing the copper should be only 0·5 to 1 ampere per square decimeter of surface, and at 0·75 to a maximum of 1·5 volts. The copper solution should consist of 3 to 4 parts of water to 1 part of the sulphate and 2 to 8 per cent. of sulphuric acid. The hydrogen sulphide is obtained by pouring dilute sulphuric acid on iron sulphide. A metallic deposit on glass, porcelain, etc., is best obtained by coating it first with gold paint and then firing, after which the deposit can be made. Or the objects may be covered with a coating of wax or resin, which is then coated with a silver solution as above described. Celluloid may be coated in the same way. Collodion or celluloid may also be coated with a solution of phosphorus in ether-alcohol added to a solution of concentrated silver nitrate. The object is then painted with the creamy precipitate which is formed. It is found that copper salts in place of the silver salts do not give such good results.

WORK ON THE BUILDINGS OF THE EXPOSITION OF 1900.

IN the following notes we shall examine the progress of the work of construction of the Great and Small Palaces of the Fine Arts, and afterward have something to say about some of the other interesting features of the Paris Exposition of 1900.

As the object of the Great Palace of Fine Arts is to replace the old Palace of Industry, it has been studied with a view to serving for the same purposes. In plan, its form recalls that of a letter H, with unequal branches, the smaller of which is represented by the body of the building bordering upon Avenue d'Antin and the larger by the body of the main building bordering upon Avenue Nicolas. This latter will comprise the monumental façade of the edifice upon Avenue Nicolas, and be occupied by a large glazed hall designed for the exhibition of sculpture, etc. Another hall, at right angles with the first, and debouching in its center, will occupy the central part of the edifice, and connect the two branches of the letter H.

The building bordering upon Avenue d'Antin will be occupied in the center by a large vestibule saloon leading to the central nave, and, upon the two sides, by exhibition halls. Exhibition galleries will run along the entire length of the façades, and around the great naves.

These galleries and halls will be distributed through two principal stories. The ground floor will be at a slightly higher level than that of the floor of the large naves, in order that its promenade may be used as a platform from which to witness horse races, etc. It will communicate, through two large inclined planes, with the central part of the basement, which will be so arranged as to serve for stables and wagon houses.

This brief exposé is indispensable in order to allow the reader to understand the details of construction.

Under the general direction of M. Girault, the supervision of the work of construction of the Great Palace was confided to M. Deglane for the front part, to M. Thomas for the back, and to M. Louvet for the intermediate part.

The grant of these various portions was made, by order of date, to the following contractors: the back part to M. Pradeau, the intermediate to M. Chapelle, and the front to MM. Nanquette & Marland.

Scarcely had the grants been made when there were installed at the different working points various apparatus that are models of their kind from the view point of the mechanical and electric forces brought into play.

These scenes of operations are connected with the wharves and stockades of the Seine, through which they get rid of their rubbish and receive materials of construction, by means of four railways passing through a tunnel excavated under the Cours-la-Reine. Three lines with portable tracks of 20-inch gage do duty respectively for the three working points, while a fourth line of 24-inch gage effects a general delivery of materials.

The handling of the large blocks on their arrival at the general depot in front of the Great Palace is done by means of a large rolling electric bridge of a power of 10 tons, running upon two rails 12 yards apart, and the interval between which is occupied by the pile of squared stone.

The same apparatus takes the stones in measure as they are needed, and carries them to the front of a diamond toothed circular saw, which cuts them to the dimensions required. For the sawing of very large blocks, a saw with an alternating motion is employed.

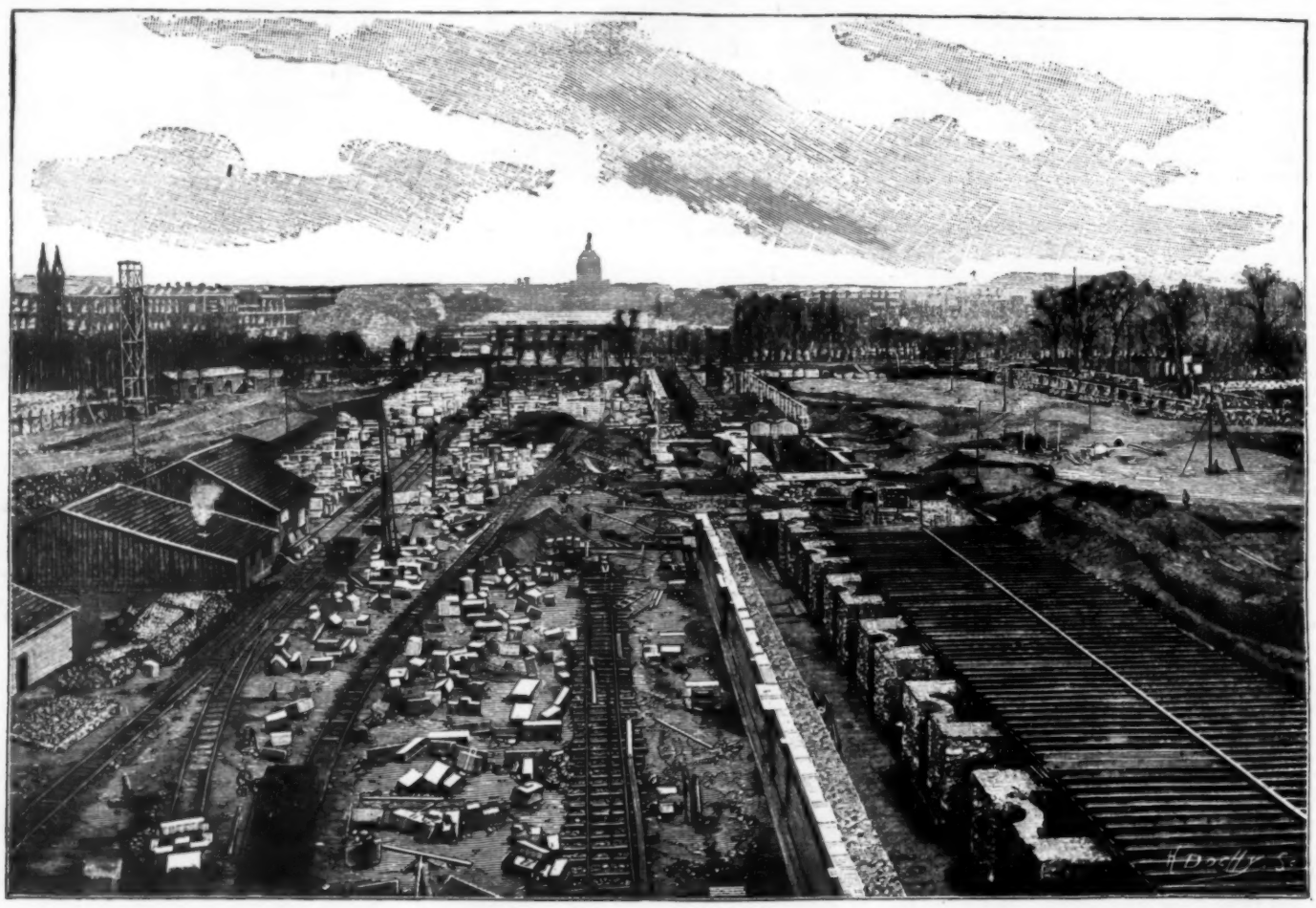
The transmissions that operate the two sawing machines are actuated by a 70 horse power Weyher & Richmond engine, installed in a shed near the sawing works. This engine likewise runs the dynamos that are used for distributing energy to the various mechanical installations and for lighting the working points.

The power is transmitted electrically to the rolling bridge, to two mortar mixers of 5½ horse power each, and to the elevator windlasses.

For actuating the elevator windlasses the two contractors of the central and back parts used the current furnished by the sector of the Champs-Elysées.

MM. Nanquette & Marland have, in addition to electric windlasses, arranged for the raising of building materials three rolling steam cranes that do duty respectively for the principal façade and the right and left sides.

The crane to the left, represented in our engraving, is pivoted and has a curved jib. It moves upon a track of 8 foot gage and is capable of raising materials to a height of 85 feet. The crane to the right, which is arranged in the same way, carries a movable arm balanced by counterpoises.



PARIS EXPOSITION OF 1900—CONDITION OF WORK ON THE PALACES OF THE FINE ARTS, MAY, 1898.

The steam crane of the main façade consists of a large metallic frame 85 feet in height, moving upon a track of 13 foot gage. At the summit of this frame is installed a pivoted crane. This apparatus is maneuvered by means of a 30 horse power steam engine installed at the base of the frame.

The immense basement that extends under the entire surface of the Great Palace was finished at the end of March, 1898. While the iron floors, masoned with hollow bricks, were being laid, the construction of the walls of the main story was begun.

The internal arrangements, as shown in one of our engravings, which represents the laying of the floor of this story, are established upon iron supports, and this will render it possible to modify the interior of the palace in the future, if it becomes necessary, without having any masonry underpinning to remove.

M. Girault, in addition to his office of architect in chief, has been specially charged with the direction of the work on the Small Palace. This structure is designed to contain a retrospective exhibition of the fine arts, and afterward to become the property of the city, which is to use it as a museum. Its general form is that of a regular trapezium, in the center of which there will be a garden in the form of a semicircle. The entire periphery will be occupied by halls and galleries, and it is upon the great base of the trapezium bordering upon Avenue Nicolas that will rise the principal façade of the edifice. The Small Palace, aside from some very small cellars to be used for the heating service, will not have any basement properly so called.

The sub-basement story is a true ground floor, on a

level with the external soil, but will serve only as a socle upon which to establish the principal story. The greater part will be fitted up for depots and secondary services.

The cut stones designed for the construction of this building are brought by trucks and then sawed and dressed by hand. The hoisting apparatus consists of a series of eight posts provided with ordinary windlasses actuated by a 25 horse power engine with teledynamic transmission. Besides, two movable hoists of 8 horse power each, worked by hand, do duty for the principal façade.

All the floors of the sub-basement, as well as those of the cellars, are of concrete, and vaulted, and without apparent beams. The system of construction consists in burying in the concrete a lattice of coarse iron wire connected with a series of coarse iron buckles exceeding vertically the rib of the irons of an inverted T section, to which they are firmly fixed. The boards are so laid as to form a continuous floor beneath the lattice-work and upon the horizontal projection of the T irons.

The concrete is poured over the whole until it has the necessary thickness above the lattice work, and is then rammed down in order to make it compact. Eight or ten days later on, the boards are removed from the base. This is claimed to be a great improvement upon the ordinary method of constructing concrete floors.

Of the numerous other architectural attractions of the Exposition under construction, one of the most interesting will consist of a restoration of some of the most notable buildings of old Paris.

Among such restorations, one of the most important will be that of the façade of the Chambre des Comptes of the sixteenth century, which was one of the chefs-d'œuvre of French architecture in the time of the Renaissance, and which was unfortunately destroyed by the fire of 1737.

This edifice, which was situated at the back of the Court of Sainte Chapelle and faced the grand entrance of the palace upon Rue de la Barillerie, was constructed during the first years of the sixteenth century, under Charles VIII. and Louis XI., who had, among the large carved or painted fleurs de lis, strewed almost everywhere such emblems as the dolphin, the porcupine surmounted by the royal crown, and the ermines of Queen Anne, of Brittany.

Three irregular pavilions with large and magnificent windows, niches, statues, a fine corner turret, and high and unequal roofs with dormer windows of the last period of the Gothic style—such were the prominent features of this façade, the destruction of which was a loss to the magnificence of Paris.

The pavilion to the right, where ended the grand external stairway, opened widely at the first story through a beautiful loggia surmounted by a high, complicated dormer window, which was rather an openwork gable flanked by high pinnacles of extreme elegance.

Aside from a few minor modifications in detail, such as placing the stairway at an angle instead of in the prolongation of the building, a proceeding necessitated by the plan of "Old Paris," which was interfered with by the Quai de Billy, the Chambre des Comptes has been restored according to the most authentic documents preserved in the National Museum, that is to say, the plans and elevations of the eighteenth century, previous to the terrible three days' conflagration that destroyed the edifice.

For the above particulars and the engraving we are indebted to the Encyclopédie du Siècle.

RESTORATION OF THE FAÇADE OF THE CHAMBRE DES COMPTES, FOR THE PARIS EXPOSITION OF 1900.

SPEED RECORDS OF UNITED STATES TORPEDO BOATS.

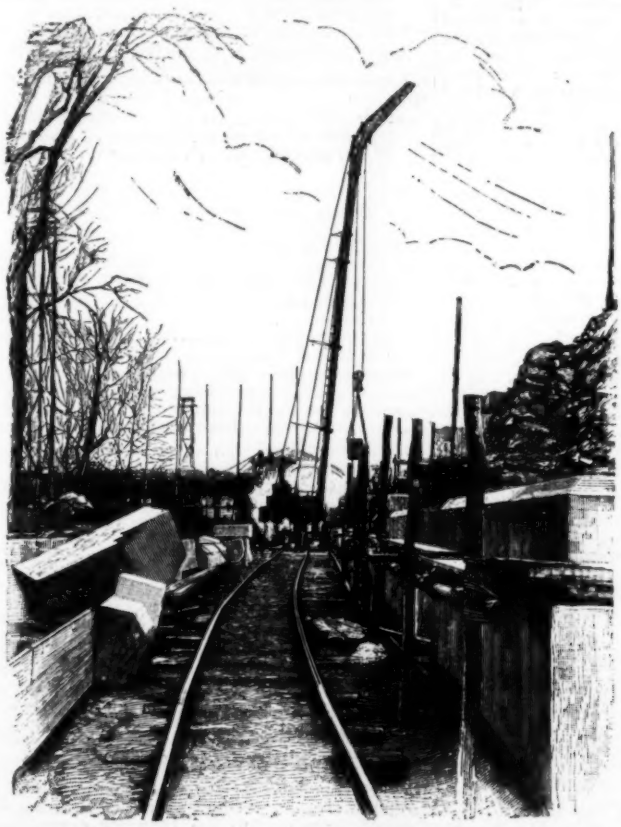
RECENT performances of the torpedo boats "Farragut," built by the Union Iron Works, San Francisco, and the "Davis," built by Wolff & Zwicker, Portland, Ore., in exceeding on their trial runs the stipulated contract speed, have directed attention to the showing made by the other torpedo boats of the United States navy. The records of the torpedo boats thus far accepted are as follows:

SPEED RECORDS OF UNITED STATES TORPEDO BOAT FLEET.

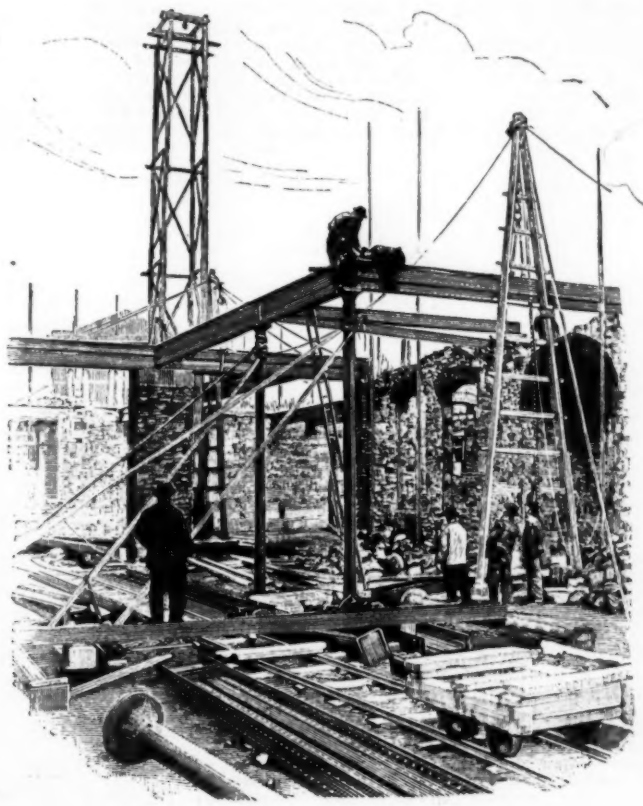
Names.	Tons.	Speed in knots. Contract.	Trial.	Contract Cost.
"Ericsson"	120	24	23	$113,500
"Cushing"	105	22	22·5	82,750
"Davis"	132	22·5	23·5	81,546
"Du Pont"	165	27·5	28·58	144,000
"Farragut"	240	30	30·15	227,500
"Foote"	142	24·53	24·53	97,500
"Gwin"	45	20	20·88	39,000
"McKee"	73	20	19·8	45,000
"Morris"	98	22·5	24	85,000
"Porter"	165	27·5	28·68	144,000
"Rodgers"	142	24·5	24·9	97,500
"Talbot"	46	20	21·15	39,000
"Winslow"	137	24·5	24·82	97,500

Figures regarding "Ericsson," "Davis," and "Farragut" are not official, but are close enough for all practical purposes.

The record of the "Farragut" in attaining the contract speed with only one mistrial is rather remarkable, considering the difficulties experienced with some of the other boats. The "Cushing" and "Du Pont" each had three trials and the "Porter" developed defects after preliminary acceptance. The "Ericsson" had several trials, and accidents resulting in the scalding of several men occurred during the trials of the "Foote" and "Rodgers." The "McKee" was accepted during the recent war without having come up to contract speed.—Marine Record.



ONE OF THE WORKING POINTS ON THE CHAMPS ELYSÉES.



OPERATION OF LAYING FLOORS.

ENGINEERING NOTES.

It has been decided by the British Secretary of State for War to apply to the whole of the horse and field batteries at home an arrangement for checking recoil, thus enabling the advantages of quick fire to be realized. This arrangement, which is the invention of the superintendent of the Royal Carriage Factory at Woolwich Arsenal, is exceedingly simple and comparatively inexpensive, and it has proved to be capable of greatly augmenting the speed of fire now attained by the service artillery.

The International Bureau of Weights and Measures at Paris has, says The American Machinist, found that when a bar consists of 36 per cent. nickel and 64 per cent. steel, the expansion from heat is only 1·50 of what we should expect from the individual components. This discovery has great importance in the construction of clocks, especially astronomical clocks, since the effect will be practically to eliminate the temperature question, which has thus far been the great difficulty in obtaining a uniform rate in timepieces.

Copper has been used for roofing very little in this country. In New York there are a few buildings having copper roofs. The best known is Trinity Church, in Broadway, opposite Wall Street, which was built over fifty years ago. The Sub-Treasury building, in Wall Street, also has a copper roof. Both have lasted many years with very little repair. Copper has been used in Europe from the earliest times, and it far outlasts lead or any other metallic roofing, but other metals answer the purpose and are cheaper, so are more generally used. Tinplate is the metal roofing most largely in use. Zinc is also used, though to a much less extent. Lead was much used in former times, but it is heavier and not as durable as copper.—Engineering and Mining Journal.

The arrangements for the development of liquid fuel appear to be making progress at the Admiralty as well as in mercantile circles, says The Engineering and Mining Journal. The experiments on the torpedo boat "Surly" are encouraging, and are leading to further developments, says Fairplay. Different kinds of oil are to be tried, so as to insure that favorable results are not dependent on one kind of fuel only. There is no structural difference between the general arrangements of a torpedo boat destroyer for burning coal as compared with burning liquid fuel; but, so far as detailed modifications are concerned to enable liquid fuel to be burned, the change can be effected inexpensively and without laying up a vessel for any great length of time. In the new destroyers which are about to be built, the possibility of the future addition of liquid fuel arrangements will, according to our contemporary, be kept in view, and in the meantime the experiments and arrangements for the continuous supply of liquid fuel are to be pushed on.

A novel method of moving a tank is described in a recent issue of the Génie Civil. The tank was used to hold petroleum, was 82 feet in diameter, 32·8 feet high, and weignt 140 tons. To remove it 131 feet, a wall 2 feet high and 1 foot thick was built on the level surface of the porous sandy soil, so as to inclose the old and new masonry foundations, which stood a few inches above the surface of the ground. The tank was built with a flat bottom and curved top, from plates 0·16 inch to 0·47 inch thick. It was first filled with air at a pressure of 8 inches of water. Then water was pumped into the artificial pond inclosed between the temporary walls until it floated the tank from its foundations, the tank then drawing 8·2 inches. More water was pumped in to raise the tank 4½ inches, and it was then hauled by a windlass and rope to its new site. It was held against a semicircular row of piles driven around the new foundation until it sank in its permanent position as the water was slowly drawn out of the pond. The tank was uninjured and its removal occupied a few minutes only.

Artillery officers who used the howitzers at Omdurman have sent in their reports on the Lyddite shell. As an explosive it does not seem to answer so well as was expected in destroying buildings. According to The Naval and Military Record, it failed to demolish the Mahdi's tomb, though several Lyddites went through the cupola and exploded inside. The building had eventually to be destroyed by gun cotton. An astonishing number of shells had also to be used to batter down a mud hut in the line of fire. But in the destruction of life the Lyddite shell is terrible. It kills all around it. Horses and men within a large area simply drop down as though the angel of death had passed over the field when the shells burst. Report says 30 per cent. of the enemy found dead through artillery fire showed no signs of wounds. They had been killed by the air concussion of the explosive. The shell was not expected to be so deadly in its effect, though better results were anticipated in demolishing buildings and fortifications. In mountain warfare the Lyddite shell would be invaluable. There would not have been such a sacrifice of life on the British side at Dargai had the howitzers been used in the Northwest Frontier war.

The authorities of the State of Massachusetts have for some time been experimenting, with the object of preventing the formation of sand drifts on the low-lying portions of the coast of that State. The method pursued has been the planting of various kinds of trees, shrubbery, and other vegetation to protect the sand from the force of the wind, and thus prevent its being carried inland. It seems that the early attempts failed, owing to the action of the sand blast, which would cut the bark from trees and shrubs. The experts finally struck upon a native beach grass known under the scientific name of Ammophila arundinacea, which has proved itself able to withstand the cutting action of the shifting sands. This grass is pulled up by the roots in places where it grows thickly and is planted in tufts from 12 to 24 inches apart. It is said that the grass is easily planted and that it thrives well in the sand. As an experiment, 90 acres of dunes have been planted with this grass, the result being that the sand is held without a break. It is planted only on the windward slopes, as on the leeward slopes the sand is not exposed to the action of the wind. Subsequent to the planting of the grass, pine trees have been started in connection with the grass and are said to be doing well.

ELECTRICAL NOTES.

The Chief of the Bureau of Ordnance, United States Navy, Capt. O'Neill, says: "Experience has shown that guns in turrets operated by electric power can be laid upon and more accurately made to follow a moving target than when operated by steam, hydraulic, or pneumatic power. There are no water pipes to freeze, no steam pipes to burst, and no delay in obtaining a full working pressure, and no troublesome or noisy exhaust pipes to deal with. A burned-out fuse can be replaced quickly or a broken wire repaired, and as the wires can be led below the armored deck, there is little liability of the latter becoming necessary."

The first section of the electrical stage appliances at the Theater Royal, Drury Lane, designed by Mr. Edwin O. Sachs, is finished. The area of the stage, movable by mechanical power, now exceeds 1,100 square feet. Mr. Sachs' installation primarily comprises a series of large "bridges," with the aid of which the finest terraces can be formed in a few seconds, or the deepest caves arranged for underneath the stage by simply pressing a button. Whole scenes, says The Times, can be rapidly raised or lowered and transformations made with the greatest ease. The introduction of modern mechanism on these lines will open an entirely new era in the mounting of plays.

A $5,000,000 contract for steam and electrical machinery has been awarded to the Westinghouse Electric and Machine Company, of Pittsburg, Pa., by the Third Avenue Railroad Company, New York city, says Engineering News. The plans of the railway company, in so far as they have been announced, include the erection of an immense power house with a capacity of about 64,000 horse power on the company's property at 216th Street, New York city. The conduit electric system will be installed on all of its lines. It is also understood that the company contemplates the sale of surplus power after the plan proposed by the Metropolitan Traction Company.

L'Eclairage Electrique gives some data of the new electric boats ordered from an English company by the Russian government. These boats are 32 feet long, 8 feet beam, draw 40 inches of water, and can accommodate twenty passengers each. They are built of mahogany with bronze trimmings, and each is operated by forty elements of accumulators in watertight, hard rubber boxes. All of the elements are permanently connected together in series, and speed regulation is accomplished by the use of two separate windings on the motor armature, which is provided with two commutators. These windings are put in series or parallel after the well known fashion used in street railway motors. With 10 horse power the speed of these vessels in still water is 12 miles per hour, and the outfit can run at full speed for four hours. At an output of 5 horse power the battery will work for eight hours without recharge and the speed is very little reduced.

The map showing the distribution of electricity from Les Clus Yverdon system in Switzerland is very interesting to examine. There is the very long trunk line which ends at Mont-la-Ville, and the other branch which, starting from the station, goes to L'Aubuson. The power taken from the line by each of the places it passes is marked on the map. There is Champion with 3 kilowatts and Mont-la-Ville 35 kilowatts, and so on. The force of power is the fall of the river Orbe, a feeder of Lake Neuchâtel, a masonry dam being built at the village of Ballaigues. The water is conveyed by a canal for a distance of about two miles to the turbine. The head is 150 feet, the quantity of water 350 cubic feet per second, while the output of the station is 1,800 horse power. The turbines are of the Picard and Pictet type and the alternators of the Oerlikon. The total length of the primary lines is thirty miles, the voltage is 5,200, which is reduced to 120 at the secondary circuits of the transformers.

Electrical Turret Turning Gear.—Lieut. William R. Rush, who had charge of one of the turrets of the United States steamship "Brooklyn" during the late war, in a recent report, indorses fully a report of a board in favor of electrical turning gear, as follows: "The board begs to reiterate its unqualified approval of electricity as the power for training turrets. To anyone who has trained turret guns upon a target by electricity, and who has afterward attempted to do it by any other means, the contrast is too striking ever to be forgotten. The electric motor and controller give perfect control and fineness of train to an ideal degree." Lieut. Rush adds, says The American Electrician, that after experience in handling turrets under fire in a running fight of four hours he found the temperature of the closed handling room of the steam turrets was terrible in comparison with that of the electric turrets. There was also the danger of death to everybody in the handling room from shell cutting a steam lead.

The Railroad Gazette publishes some figures of the cost of operating street railroads in New York and Chicago from a paper read at Stevens Institute by Arthur J. Wood. While the electric conduit roads are operated here at a cost of 10·23 cents a car mile, in Chicago the cost for trolley roads is 13·051 cents. The cable roads in New York cost 16·35 cents a car mile to run, while in Chicago the cost is only 10·706 cents. In Connecticut nineteen trolley roads, each of which carries more than a million passengers a year, show an average working cost per car mile of 13·83 cents. The figures for New York and Chicago are:

	New York.		Chicago.	
	Electric Conduit.	Cable.	Trolley.	Cable.
Transportation	6·15	7·78	5·934	4·567
Maintenance of way	0·33	3·54	1·482	1·278
Power	1·70	2·02	1·082	1·151
General expenses	1·22	2·07	2·593	2·594
Maintenance of equipment	0·83	0·94	1·960	1·116
Total per car mile	10·23	16·35	13·051	10·706

Miles run:	New York.	Chicago.
Cable	11,991,000	13,562,610
Electric	7,110,000	24,378,000
Horse	15,995,000	198,860

Mr. Wood holds that New York can afford to build electric conduit roads, but other cities cannot. For them the cable is cheaper.

SELECTED FORMULÆ.

English Carriage Greases.—The following recipes and directions for making the ordinary kinds of carriage grease are up to date, according to Oils, Colors, and Drysalteries, from which we copy them:

COLORED CARRIAGE GREASES.

(Continued from page 19269.)

4. Grayish Black.

Mix 50 pounds of pig's fat, and carefully stir in 10 pounds of finest levigated graphite.

5. Grayish Black.

Spermaceti	80 pounds.
Yellow wax	40 "
Tallow	160 "
Pig's fat	40 "
Finest levigated graphite	2 "

Mix the first four ingredients thoroughly by heating them together in an iron kettle, and then stir in the graphite.

6. Brownish Black.

Soapboilers' lye	200 pounds.
Water	200 "
Resin oil	600 "
Soot	2 "
Coal tar oil	120 "
Wood tar oil	48 "

Boil up the lye and the water till quite fluid. Then add the resin oil, then the soot, and then the tar oils, stirring all the while. Finally add 480 pounds of slaked lime.

7. Bluish.

Unslaked lime	75 pounds.
Rectified heavy tar oil	125 "
Resin or paraffin oil	125 to 350 "

Slake the lime to a thin paste, then heat up and add the tar oil. At 50° C. the lime unites with the oil, and the water separates out and must be run off from underneath. Let the temperature of the kettle then fall to about 25° C., and add the other oil, stirring well. The result has the consistency of butter, and has a bluish color.

8. Blue.

Finest levigated graphite	15 pounds.
Ultramarine	15 "
Soft soap	30 "
Pig's fat	120 "
Colza oil	15 "

Mix all well, except the colza, which add last, and mix again.

9. Blue.

Train oil	240 pounds.
Slaked lime	160 "
Resin oil	900 "
Coal tar oil	100 "
Wood tar oil	25 "

Having mixed the tar and resin oils, stir in the train oil and lime, which have been previously mixed. Add this rapidly, and stir till the whole mass sets.

10. Brown.

Add tar oils to the white grease No. 1.

11. Violet.

Substitute Frankfort black for the soot in recipe No. 2.

12. Yellow.

Red American resin	30 pounds.
Boiling water	125 "
Soda	10 "
Slaked lime	25 "

Melt the resin, add the boiling water and soda, then the lime little by little; of course, with constant stirring and boiling. Color with rectified resin oil.

13. Yellow.

Red American resin	200 pounds.
Soda lye (20° B.)	25 "
Raw resin oil	25 "

Saponify the resin with the lye, and stir in the oil.

Liquid Finger Nail Polish.—The Era Formulary gives this one:

Sulphuric acid	5 drops.
Tincture of myrrh	1 drachm.
Water to make	4 ounces.

Mix.

First clean the nails with a stiff brush and soap, and then plunge them into the above mixture and hold them there for five minntes.

Most nail polishes, however, contain oxide of tin, and may be either pastes or powders. The following preparation has been found very satisfactory:

Oxide of tin	4 pounds.
Carmine	¾ ounce.
Oil bergamot	150 grains.
Oil lavender	150 "

Sewing Machine Oil.—Sperm oil, to which a little kerosene oil has been added, makes a very satisfactory lubricant for sewing machines and other light machinery. We also submit the following formulas:

1. Soft paraffine	1 part.
Paraffine oil	7 "

Melt the soft paraffine and add the oil. Allow to stand for some hours and then pour off the liquid.

2. Chemical Recipes, an English publication, is authority for the following:

Pale oil of almonds	9 ounces.
Rectified benzoline	3 "
Oil of lavender	1 "

Mix and filter.

3. Petroleum	3 ounces.
Essential oil of almond	½ drachm.
Pale nut oil	9 ounces.

Mix and filter.

Sensitizing Solution for Paper.—

Silver nitrate	6 parts.
Magnesium nitrate	6 "
Distilled water	50 "

Each time after sensitizing a sheet in this solution, 1 drachm of a one-to-eight solution of nitrate of silver should be added to the bath for every 100 square inches of paper sensitized.

THE BARBER SHOP AS A MENACE TO HEALTH.*

By A. WALTER SUITER, A.M., M.D., Herkimer, N. Y., Examiner in Physiology and Hygiene, New York State Board of Medical Examiners.

IT seems that the time has arrived when the attention of this Association, and, through it, that of public health authorities in general, should be called to that part of personal hygiene which applies to the barber shop.

It is astonishing that while the sanitary relations of most, if not all, other public occupations have been investigated to the minutest detail, and salutary restrictions, in many instances of the most rigorous character, have been imposed to protect the public interest, the first attempt to regulate the operation of the barber shop and to apply to it the rules of sanitary administration has been made within two years.

That this common mode of infection should have for so long escaped authoritative attention in these days of asepsis and antisepsis may be noted as one of the most contradictory circumstances of our times.

To point out the necessities for reform in this respect will be the purpose of this brief paper, and the writer does not expect to do more than furnish a text for such remarks or such action on the part of the Association as will tend to bring the subject properly to the notice of local health authorities, who alone have the power to act in such premises.

Historically, the barber has, from a very remote period of antiquity, held an important station among the occupations of the world. He was, in a certain sense, the progenitor of the surgeon and the dentist of the present day, and in ancient times was invested with professional rights and privileges by government sanction which might well excite the envy of his offspring. To him was given the exclusive right to practice phlebotomy, which was until a somewhat recent date regarded as the most effective therapeutic agent known for the alleviation and cure of most of the diseases to which the human race is heir. Then, as now, the barber shop was a "focus of news" and "the favorite resort of idle persons," and the professional barber and hair dresser enjoyed the worldwide reputation for gossip and garrulity which is so familiar to us all.

By act of incorporation they were made "professors of the healing art" in England in 1461, during the reign of Edward IV., and so continued during the reign of George II. (A. D. 1726–1760), when the barber and surgeon were formally divorced.

We have some reason to believe that even in the remote periods mentioned attention was given to the subject of sanitation in the selection and arrangement of the utensils made use of in their professional employment. Cleanliness was invariably provided for—a fact which is instanced by the symbol of the brass basin which has, for all time, been suspended from the striped pole which still constitutes the sign of the barber in many countries. This brass basin was always made with a crescent-shaped space cut into the side to receive a man's throat and thus prevent the soiling of clothes with the lather and other substances which were applied in the operation of shaving the beard. Again, it is worth noting that even in ancient Greece and Rome barbers and bathers were associated in their labors and rivaled the physicians of that period in the practice of their art. Later on, in France, the "Society of Barbers and Bathers" was accorded the privilege of practicing all sorts of surgery in spite of the protests of the regular surgeons. Barbering and bathing are to some extent associated in our time, but not to the extent comprehended by the subject of these remarks, it is a matter of regret to state.

If, as we presume, the sanitation of cleanliness was observed by the barber surgeons of medieval France, the system must have degenerated to the present date; for, as was above mentioned, the first attempt of modern times to regulate sanitarily the operations of the barber shop was recently made in the city of Paris. As a police regulation and by direction of the sanitary authorities, an order has been promulgated requiring that specific rules of asepsis and disinfection shall be observed in all shops for the protection of the public. These directions include the use of only metal combs, in order that they can be easily sterilized, and that, as far as possible, all instruments shall be of metal; that the razors, clippers, scissors, combs, and the like, shall be subjected to a heat of 100° C. before and after use; that the shaving brushes must be washed before and after use in boiling water, and that the hands of the barbers shall be thoroughly cleansed before passing from one customer to another. They are required to use sterilized towels and pulverizers in place of the common powder puffs, and the hair that is removed is to be disinfected and promptly taken from the room. Chemical solutions are also prescribed, for obvious purposes.

The writer is not informed as to the method by which it will be made certain that these regulations will be faithfully observed, but doubtless a system of inspection will be inaugurated under police surveillance which will insure detection in case of non-observance and the proper punishment of all offenders.

When advised of the promulgation of this order by the Paris Health Department, the thought at once occurred that the same might well be universally adopted as an important reform in the matter of local sanitary administration. As individuals we are constantly reminded of the grave personal dangers which threaten the patron of the average barber shop, and many of us have long since adopted measures of prevention for self-protection. The writer's experience does not differ from that of many others who have professional knowledge of the communicability of pediculi and disease. The magnificent (?) beard which he now presents to your view is the result of an occasion when a characteristic danger was imminent. One evening several years ago a sheepish looking individual shuffled his way into my office waiting room and requested a prescription. He was observed to be suffering from syphilis and presented a most unattractive appearance; his face was literally covered with eruptions and his mouth and lips were ulcerous in a high degree with the form of manifestation known as "mucous patches." His hair was fast falling, and, in short, he was a perfect focus of infection. His case was disposed of and he was gladly dismissed.

Having to take an early morning train, I shortly afterward proceeded to the barber shop to prepare for my toilet. My barber's chair was occupied and I sat down to await my turn. As the occupant was about to arise I was startled to observe the very patient for whom I had prescribed an hour previous!

It is needless to say that I took my departure, although I was obliged to exercise some finesse in order to avoid exposing the professional secret that had been confided to me. Neither did I dare, for the same reason, to offer any suggestion for public protection. Instances with this latter feature in this and other relations are constantly occurring to physicians, as all who listen will appreciate.

Then and there I resolved that my face should never again be shaved by a barber, and the result is apparent. I also adopted a plan for my occasional visits to the barber shop for the trimming of hair and beard. Carrying always a packet containing shears, comb, brushes, and clippers, I insist that everything be removed from the chair, clean towels be substituted, and that the barber thoroughly wash his hands before proceeding; and for all this I tender him (beforehand, if a stranger) a fee so large that he cannot complain of what ordinarily seems to him a hardship. The only inconvenience I experience is that among the tonsorial fraternity of my vicinity I am compelled to bear the somewhat unsavory name of the "champion crank of the town."

This item of personal observation is introduced to direct attention to only one phase of the many dangerous situations which will readily occur to the sanitary mind, and it seems entirely unnecessary in this presence to attempt to elaborate this simple note of warning and protest by offering illustrative examples.

Instances almost without number might be collected and presented to prove the transmission of various diseases by the methods commonly practiced in tonsorial operation. Pages might be written from the scientific standpoint to show the prevalent violation of well established hygienic principles and the possibilities of parasitic and bacteriologic communication. Such an effort would be a work of supererogation indeed. The assumption is quite warrantable that there is scarcely a step in the processes usually employed by the barber which does not carry an element of danger when the most careful precautions are not observed. There is probably not a physician of considerable experience who could not cite examples which have occurred in his observation to support the argument presented, but it may well be doubted whether even with such precautions as might, and sometimes are, made use of in the ordinary way, such articles as combs, brushes, and sponges would still be unclean and capable of conveying vitalized elementary substance from one person to another. Take the matter of sponges, for example. No surgeon thinks of using one a second time, unless it is passed through a process of disinfection requiring an amount of time and labor which more than covers the cost of a new one, and yet in many, if not most, barber shops the same sponge is repeatedly used from face to face, with nothing more than a simple squeezing between each sitter, which cannot remove the infected blood or pus from the often broken or eruptive cuticle.

In the opinion of the writer, it is absolutely impossible, no matter how good may be the intention, to properly cleanse and sterilize any of the instruments employed without consuming an amount of time and material which would render such an effort impracticable. Hence it appears that nothing short of such compulsory regulations as have been adopted by the Paris authorities would be effective. Local administration of this character should be made to apply to every barber shop, whether rural or urban, and a system of inspection established to enforce the rules. There will be found in many localities some items which the Paris regulations do not seem to cover, such as the particularly dangerous use, from patron to patron, of the alum stick to stanch the flow of blood from the cut cuticle, the common use of the block of magnesia to complete the drying of the newly shaven skin, both of which articles sometimes do continuous service for weeks for the occupants of the same chair. Of course, these remarks do not apply to all shops, as many of them are kept as cleanly as is possible without scientific disinfection, and most of the better class of barbers would gladly join in the movement of reform if a proper opportunity were offered.

The Legislature of the State of New York has had for a year or two past a proposition pending for the enactment of a law which would, in a great degree, serve to correct many of the evils referred to here. This bill emanates from a representative organization of the barbers themselves, and has the uniform support of all the better classes among them. They desire the law for self-protection and to elevate the general character of their business. By the provisions of the proposed regulation, a board of examiners will be appointed, which will proceed to qualify the members of the trade by systematic examinations of such a nature as to demonstrate the fitness of each individual applying for a license, and no one can practice except he is so qualified. It is understood that the knowledge of the scientific rules for disinfection and general sanitation will be an integral part of the requirements. This measure will be pushed during the coming session, and the Barbers' Association will receive the support and active aid of the medical societies. Should it be enacted and health boards in general promulgate the rules of asepsis and disinfection by which to enforce the provisions of the law, nothing more can be desired.

It is understood that in Germany the general regulations for the licensing by examinations of all occupations in great part solves the problem of sanitation in barber shops, as only those are licensed who are especially qualified from all points of view. Such a system should be made applicable in all states and countries. Horseshoers are thus qualified in the State of New York, and why is it not just as important to regulate barbers in the same manner?

It is remarkable that since this information has come to us from abroad the medical journals and newspapers are teeming with commendatory comments, and wonder is often expressed why this subject has been for so long officially unnoticed. Without doubt the people will be quickly educated to the necessity for action, and the efforts of health boards will be supplemented and facilitated by favorable public sentiment.

Let us adopt for our motto in this respect the Spanish proverb, "Dicho y hecho" (no quicker said than done), and with the greatest promptitude practicable demand that an intelligent and unprejudiced inquiry be made into this fruitful source of disease transmission, to the end that the fundamental principles of sanitary science may be made to apply to it as well as it does to many less threatening situations.

If the surgeon and the dentist are morally and, in a negative sense, legally, under obligations to disinfect and sterilize in all cases their instruments before using them, why is it not just as reasonable to hold a barber equally responsible for neglect of such precautions? And why should it not be properly within the province of health boards to protect the public in this regard, and quite within the jurisdiction of this Association to add its powerful influence toward the promotion of the means for the accomplishment of this much-to-be-desired reform? We are constantly striving to regulate the disinfection of railroad sleeping cars, passing ordinances to subvert the dangers of the spitting nuisance, loudly demanding the substitution of the individual for the common communion cup, and in divers other fields are endeavoring to compel the proverbially heedless public to have a care for their own welfare, but it may well be said that the hygienic regulation of the barber shop far exceeds in importance the most of these undertakings.

* Read at the annual meeting of the American Public Health Association, Philadelphia.—From The Sanitarian.

X-RAYS IN THE ARMY.

By H. LYMAN SAYEN.

WHEN the operations of the army near Santiago indicated the necessity of providing for the wounded in the United States, where better care, more healthful surroundings, and better food could be obtained than was possible in Cuba, the government selected Fort McPherson, Ga., as one of the receiving points. Situated four miles southwest of Atlanta, on a tableland 1,000 feet above the sea level, its pure air and water, excellent sanitary arrangements and central position in the South made it an excellent site for a general hospital for the army in the field.

Early in July I was ordered by Surg.-Gen. Sternberg to report for duty at the post in connection with X-ray work. Upon my arrival there I found that the finely equipped post hospital was used partly as an executive building and partly for sick and wounded officers. Immediately adjoining the hospital building is the laboratory building, one portion of which was the surgical operating room, well equipped with modern surgical appliances, while another part of the building was devoted to the biological laboratory, and it was here that the X-ray work was done.

The room was well suited to the work, and, as the water supplied to it was from an artesian well over 2,000 feet deep, it offered exceptional facilities for the developing and printing. I had the shutters covered with an opaque, black oilcloth in order that the room might be made absolutely dark even when the brightest daylight prevailed outside. It was found essential to do this, not only for photographic purposes, but for the fact that it seems impossible to do satisfactory work in daylight. It is a matter of ten minutes or so for the eyes to accommodate themselves to the fluoroscope after being exposed to daylight, and it is impossible to keep them glued in the fluoroscope and at the same time manipulate the X-ray apparatus in a light room.

The original equipment of the X-ray laboratory contained as a generator an eight-plate static machine with plates 28 inches in diameter, running in ball bearings. The plates were in a moisture-proof case, which also contained a double-plate Wimshurst as an exciter. The main plates were driven by a large hand wheel, which made one turn to four or five of the plates.

The apparatus was of excellent workmanship and, under conditions less exacting than this instance, might have performed the work required of it. While the writer's experience in the use of the static machine in connection with the generation of X-rays has been somewhat limited, a study of the conditions existing in this form of machine, together with the actual working of the apparatus at the post, leads to the conclusion that the static machine is theoretically and practically an inefficient current generator, aside from the fact that the highly humid Southern climate rarely permitted its use in this particular instance.

A static machine depends for its excitation on the potential induced at its terminals, and, as a consequence, when running at a low potential, as on a tube of low vacuum, it does not generate a sufficient quantity of current. The addition of a spark gap in series with the tube improves the output of the machine, but there is more energy lost in the spark gap than used in the tube. That is, if the machine is not running at a potential equivalent to a long spark, it will not generate enough current to properly illuminate the tube. A tube with a vacuum corresponding to a parallel spark gap of about 3 inches gives the most satisfactory results. When connected to a static machine, in order to get enough current through the tube, it is necessary to add a spark gap in series with it about 6 inches long. It will be seen from this that the machine, in order to give the proper current, generates three times the energy necessary; or, in other words, a 4-inch spark from an induction coil would do the same work, while the apparatus required would occupy but about one-twentieth of the space.

In view of the exigencies of the work Messrs. Queen & Company, Philadelphia, kindly loaned the writer a 14-inch induction coil, together with a number of their self-regulating tubes, while Dr. T. P. Hinman, of Atlanta, volunteered the use of his laboratory for the purpose of charging the batteries to run the coil, no electrical plant existing at the post.

The wounded sent to the post included those who were in the fight at El Caney, and in practically every case the X-rays were employed for diagnostic purposes. The difficulty of obtaining suitable photographic plates early in the work compelled reliance upon the findings of the fluoroscope, the location of bullets being marked by ink spots upon the flesh. In the case of fractures the surgeon in charge of the patient was enabled to verify the position of the bones,

The number of wounded during the war that required the X-rays was by no means large, but the cases of injured received at Fort McPherson were of such a varied character as to fully emphasize the value of the new form of radiant energy in all field and hospital work during the war. While it is not my province to comment on the surgical aspect of the subject, I believe it to be the opinion of surgeons of experience that the older method of probing for bullets, with the consequent danger of carrying infection to the wounded parts, should be abandoned in favor of the X-rays. There is also the important factor of accuracy in the X-ray determinations, enabling the surgeon to remove the bullet through a small opening in the tissues.

All the operations of the surgeons at the post were successful in removing the bullets from the exact location, as indicated by the radiographs, and in many cases it was impossible to determine the nature of the injury except by means of the plates. The presence of some of the bullets was even unsuspected, as is shown by the case of J. R., private, Company C, Second Infantry. He was wounded at Santiago and arrived at McPherson with two pieces of lead in his arm. The presence of the larger piece was unsuspected, the smaller piece being so near the surface that recourse to the X-rays was considered unnecessary. A subsequent stiffness and soreness in the arm, however, gave rise to an X-ray examination, resulting in the successful removal of the bullet.

The present war is the first instance that our army medical department has had occasion to use X-ray apparatus to any practical extent. Apart from the novelty of the new force, there is not the opportunity in the army in time of peace to determine the value of improvements of this nature as is afforded the general hospitals.

The X-rays in the army are essentially an equipment for war, and in those times when the medical department is taxed to the utmost there is the utmost importance that they should have every facility to help in the successful treatment of the injured. Not only are the rays valuable from the standpoint of their immediate usefulness, but too much importance cannot be placed on the fact that, as records, there is nothing better or more accurate than a radiograph. In the case of J. R., should he try to obtain a pension, could there be found any better evidence of the fact that his bones are uninjured and that the possibilities of a permanent injury resulting are exceedingly small? If, together with the radiograph, there is kept an accurate history of the different cases, we have an indisputable account of the effect of gunshot injuries.

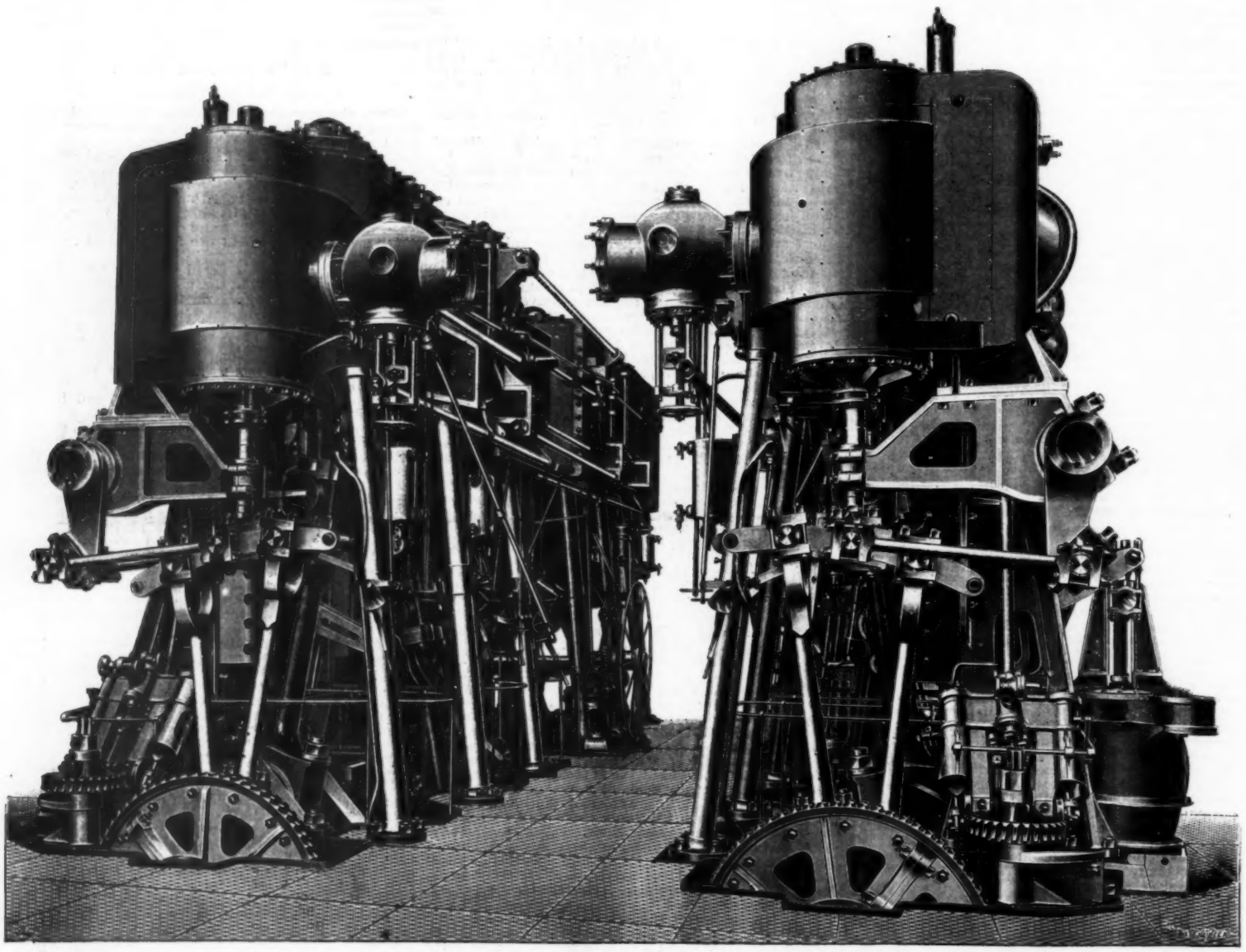
It certainly seems that the recent developments in the design of X-ray apparatus have advanced it to such a state that there are great possibilities for the adaptation of it to work in the field. A covered wagon, drawn by two mules, would furnish the dark room as well as the means of conveyance. It should be in charge of two men, who should be so trained in the work that they would, between them, know how to take care of everything from the secondary of the induction coil to the hoofs of the mules. In the wagon might be placed a 12-inch induction coil so made that every part could be immediately removed and replaced by another, of which the wagon should contain a complete set. It should also contain, besides a complete supply of tubes and photographic apparatus, a little dynamo and windlass so the mules could put in their spare time in charging the storage batteries (although this seldom has to be done, as my experience at Fort McPherson demonstrated). A thousand pounds would cover the weight of the apparatus, and with such an equipment the wagon would be as independent as a company of infantry. The operators could bunk in their ambulances besides carrying a plentiful supply of rations.—Electrical World.

ENGINES OF H. M. S "DIADEM."

THE boilers of the "Diadem" are of the Belleville pattern, but, unlike those of the "Powerful" and "Terrible," they are fitted with economizers, the number of rows of 4¼-inch generating tubes in each element has been reduced from ten to seven, while over the generating tubes there is a space provided corresponding to that of the combustion chamber in an ordinary return tube cylindrical boiler, and above this space is situated another nest of tubes of smaller—2¾ inches—diameter, and seven rows in height, forming the economizer. The furnace air-blowing engines supply jets of air to this space as well as into the furnaces below. The feed water is pumped into the lower part of the economizer, traverses to the top of its elements, and from thence it is led to the steam collector for feeding the generating tubes. The advantages of this arrangement are that the combustion is more effectually completed, the escaping funnel gases are of a much lower temperature, firing does not require so much attention, and economy in fuel is obtained. The boilers are thirty in number, twenty of them containing eight generator elements and six economizer elements, six having seven generator elements and six economizer elements, and the remaining four containing nine generator elements and seven economizer elements; this arrangement being to suit the width of the stokeholds.

The boilers are arranged in four water-tight compartments, with tubes running fore and aft, eight in each of the three after and six in the forward one, placed back to back in each compartment. There are four funnels, with practically vertical uptakes. The total heating surface of generators and economizers is 40,550 square feet, or 2·46 square feet per maximum specified indicated horse power. There are four main feed pumps and four auxiliary feed pumps, but, unlike the "Powerful" and "Terrible," the main feed pumps and separators are placed in the boiler compartments instead of in the engine rooms.

The propelling engines of the "Diadem" consist of two completely independent sets of four-crank, triple expansion inverted cylinder type; two low pressure cylinders being fitted. The diameters of the cylinders are as follows: High pressure, 34 inches; intermediate pressure, 55¼ inches; two low pressure, each 64 inches. The stroke is 4 feet, with a designed cut-off in the high pressure cylinder of 73 per cent. The ratio of low pressure to high pressure cylinder volume is 7·08. Allowing for a clearance in the high pressure cylinder of 25 per cent., and in the low pressure cylinder of 15 per cent., the designed real ratio of expansion at full power was about 8·3. The ratio of low pressure to high pressure cylinder volume in the "Powerful" is only 5·7 to 1. The superiority of the ratio given by the "Diadem's" engines, as just quoted, may account in some measure for their superiority in working. The maximum pressure at which the engines were specified to work was 250 pounds per square inch, with a boiler pressure of 300 pounds, an increase of 40 pounds beyond that specified for the "Powerful" and "Terrible." For our engravings and the foregoing particulars we are indebted to The Engineer.



TRIPLE EXPANSION ENGINES OF HER MAJESTY'S CRUISER "DIADEM."

THE SUPPLY AND WASTE OF SHIPPING.

IT is now possible to arrive at an idea of the number and tonnage of merchant vessels removed during the year 1897 from active service, either by misadventure or the natural process of decay, and it is interesting to note that the total is much smaller than usual; but a closer examination does not quite afford subject for gratification, for there is no decrease in the number of ships which met a violent end, and thus no diminution in the risk run by the mariner. The cause for the less waste is to be found in the fact that fewer ships have been "broken up, condemned," etc., and as the law of decay is much more constant in respect of ships than of men, this mortality from natural causes is doubtless due to the fact that the higher freights lately obtainable have encouraged shipowners to postpone the day of dissolution for the sake of an extra voyage. Nor are they to be blamed altogether, for, as it is often a case of the "survival of the fittest," a steamer which is not modern may still be structurally fit, and yet, owing to her inferiority on the score of economy, may be able to work, if only freight rates are good. The recent revival in rates has in many cases been sufficient to change the balance from the debit to the credit side of the ledger of such ships, and thus we find a falling off in the number of

vessels broken up. For the three preceding years the cold winds of depression steadily raised the number of vessels which thus passed the narrow border between usefulness and decay. In 1894 the number was 227, of 149,296 tons; in 1895, 247 vessels, of 170,849 tons; in 1896, 338 vessels, of 186,149 tons; and now last year there was a few months of the sunshine of prosperity with good freights, and the number is only 176 vessels, of 143,923 tons, or 25,000 tons less than the average of the three preceding years. When the separate quarters of last year are taken into account, the tendency is the same. Thus the June quarter showed 43 vessels, of 42,295 tons, broken up or condemned; the September quarter, 35,325 tons, and the December quarter 29,520 tons. Only during the last three months of the year 1897 does Britain directly show the tendency to which we have directed attention. In the last quarter only five vessels of 6,864 tons were broken up or condemned; but prior to that the normal for several years—15,000 to 17,000 tons per quarter—was maintained. The same end is probably attained by selling the old ships in prosperous times at good prices to foreign owners; but the returns of such transfers are not yet completed.

The decrease in tonnage removed is thus entirely accounted for: the total for 1897, when compared with 1896, shows a gross decrease of nearly 52,000 tons, while, as we have shown, the ships broken up or condemned show a decrease of 43,000 tons. The total for 1895 was abnormally high, so that as regards losses by misadventure, it may be said that there is no distinct change. Fleets have grown very considerably in the interval; the British, for instance, has gone up from 10½ to 12¼ million tons in six years. This stationary total of losses is thus very satisfactory.

There may be one or two isolated cases of losses yet to add to last year's list; but it will not materially alter the fact that the waste of shipping which builders have to make good is considerably less than was the case in the three preceding years, but this is not affecting the industry at the moment, for it is now experiencing unprecedented activity. The merchant tonnage launched in Britain during the past six months exceeds the year's waste for the world, and the merchant tonnage now building in this country alone is nearly double the waste of last year; so that this excess, or 620,000 tons of shipping, is being provided here for meeting the world's expansion of trade, without taking note of the increasing production of other countries, or of the much greater carrying capacity of the new ships as compared with the old. Thus 677 sailing ships of 305,104 tons were removed; and these must be replaced by steamers, as practically no sailing ships are being built. The steamers, ton for ton of measurement, will carry per annum three to four times the cargo of the sailing ships, so that 100,000 tons of the steamers now building will make up the year's waste of sailing ships, and thus the real surplus from British yards alone is increased to 820,000 tons.

LOSSES FROM ALL CAUSES.

	Vessels.	Tons.
In 1891	1086	649,946
" 1892	1008	625,224
" 1893	1154	708,971
" 1894	1237	806,278
" 1895	1051	737,779
" 1896	954	685,962

It is interesting further to note that the waste of the British fleet last year was 58,289 tons of sailing ships, and 228,000 tons of steamers, together 240 vessels of 286,349 tons. In the two preceding years the tonnage was 285,300 tons, so that for three years it has been about the same. It may be noted, however, that the ratio of sailing to steam tonnage is very much less than in the case of the figures for all countries; so that on the basis of steam carrying tonnage, our waste is not more than 247,000 tons, while for British owners there are now building in this country, merchant ships whose aggregate measurement is 1,091,681 tons, while in the past six months of the current year the vessels launched for British owners exceeded the year's waste by 200 per cent. This shows a surplus of some 700,000 tons on the year, which is a satisfactory contribution to our national wealth, and can scarcely be regarded, even by the cautious owner, as alarming when it is remembered that it only represents an addition of about 5 per cent. to the total merchant navy of the United Kingdom. When put thus it is insignificant, and any prognostications as to over-building scarcely seem well founded, for the world's over-sea commerce increases at a rate exceeding 5 per cent. per annum.

The British waste of 240 vessels, of 286,349 tons—a third of the total for the world—is not disproportionate, when it is remembered that Britain, according to Lloyd's latest returns, from which we deduce the facts for our article, show that the British fleet equals half the world's tonnage—being made up of 9,107 vessels of 12,403,409 tons, while the fleets of all the foreign powers only make up an aggregate of 14,522 vessels of 10,794,859 tons. The colonies appear on the list for 2,130 vessels of 1,079,497 tons. In other words, the loss in tonnage in the British service was 23 per 1,000 per annum, as compared with 34 in the foreign merchant navies—a difference which is as marked as it is gratifying. The same difference was noticeable in immediately preceding years. And here it may be interesting to give the total tonnage owned by the chief maritime nations, and the percentage of their losses in 1897:

	Total Ships Owned.	Total Tons Owned.	Loss in 1897 per Mille of Tonnage Owned.
Britain	9107	12,403,409	23·1
Colonies	2130	1,079,467	28·9
United States	3160	2,326,838	23·3
Germany	1623	2,029,912	20·0
Norway	2762	1,634,498	56·0
France	1151	1,162,382	33·2
Italy	1151	810,501	32·5
Spain	723	587,787	9·2
Russia	1106	550,026	24·1
Sweden	1381	622,944	40·0
Holland	374	433,774	38·9
Denmark	791	407,435	27·4
Austria-Hungary	300	328,762	52·6

The high ratios of Norway, Sweden, and Austria-Hungary are due to the preponderance of sailing ships in their fleets as compared with other powers, and, perhaps, also to the age of many of the barks possessed, while the low rate in the case of Germany is owing partly to the newness of her fleet. In six years it has increased to the extent of 20·6 per cent., but instead of having only a million tons of steam vessels she has now over 1½ million tons, the sailing ship tonnage having greatly decreased. In the case of Russia, also, there has been an extensive change, the net addition has been equal to 29 per cent., but the steam tonnage has doubled, being now 311,622 tons, while the sailing tonnage has not yet lost much. Denmark has increased her steam tonnage from 126,461 tons to 283,214 tons, without materially increasing the sailing tonnage, so that the net increase is equal to 38 per cent. The United States steam tonnage has nearly doubled from 587,442 tons to 1,105,423 tons, and her net addition is equal to 19·5 per cent. France has increased her steam tonnage from 848,525 tons to 954,916 tons, and her net increase is 7½ per cent.; Spain's increase is 9 per cent.; and Sweden's equal to 14·7 per cent., while Norway has decreased her steam tonnage and increased her sailing tonnage, and her total is about the same as it was six years ago. Britain has now 200,000 tons less of sailing ships, but she has 2,100,000 tons more of steamers than six years ago, and thus the increment, notwithstanding the already large total, is at the same rate almost as all other powers, being 18 per cent. With an increasing supply, and a diminishing waste, especially from misadventure, we do not relinquish any part of our superior position in relation to our rivals.—Engineering.

THE DIAMOND SAW.

IN passing by the places where laborers are at work in connection with the exposition to be held upon the Champs-Elysées, one is surprised at the rapidity with which the stones are piled one upon another and with which the future great palaces are rising from the ground. On every side are seen immense heaps of large stones, which a few days afterward disappear as if by enchantment in order to give place to others.

At the scene of operations, in fact, there is a very remarkable tool, a diamond saw, which cuts up these stones and furnishes all the blocks necessary for construction purposes. This new saw is due to M. Felix Fromholt, of Paris, who utilizes therein crystallized diamonds worth from 10 to 15 francs per carat, and who has devised a special method of inserting this mineral in blocks of steel for the manufacture of saw blades.

In the circular saw now employed, the apparatus consists of a cast iron frame projecting from a masonry foundation. The saw is mounted upon a shaft fixed upon the frame and carrying a pulley which is actuated by a flywheel that receives its motion directly from a 10 or 12 horse power steam engine. A loose pulley permits of stopping the engine at will. This arrangement is adapted for a rapid running. In the case of slow running, the shaft receives its motion through the intermedium of a belt.

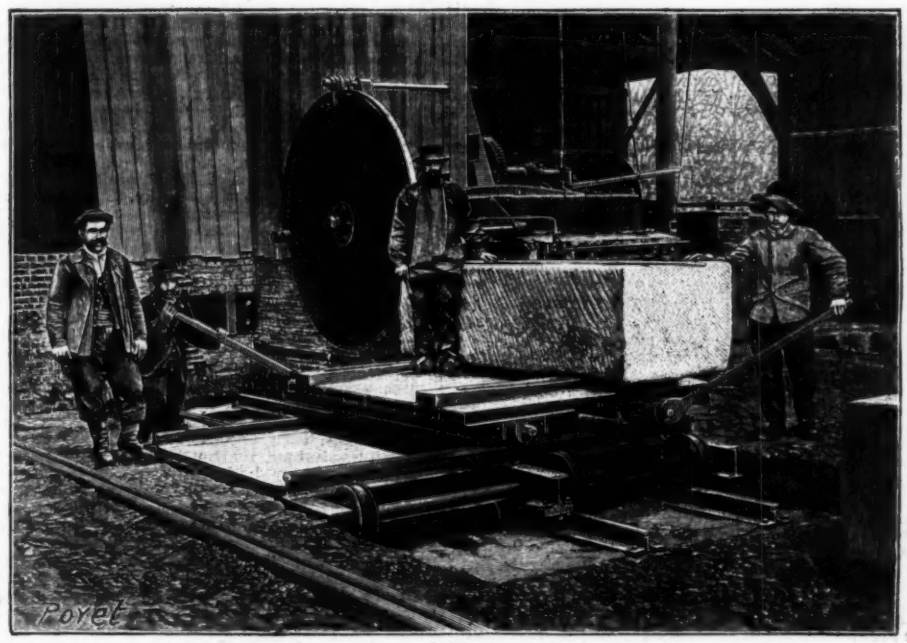


FIG. 1.—GENERAL VIEW OF THE FROMHOLT DIAMOND SAW.

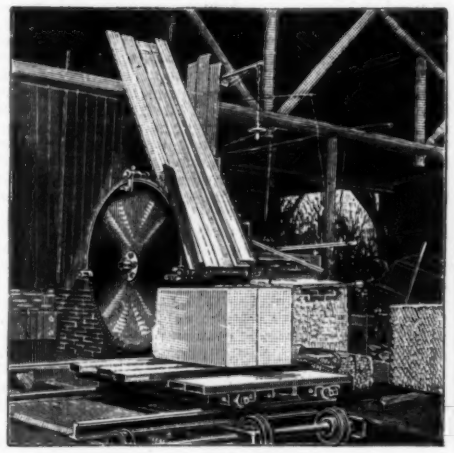


FIG. 2.—SIDE VIEW.

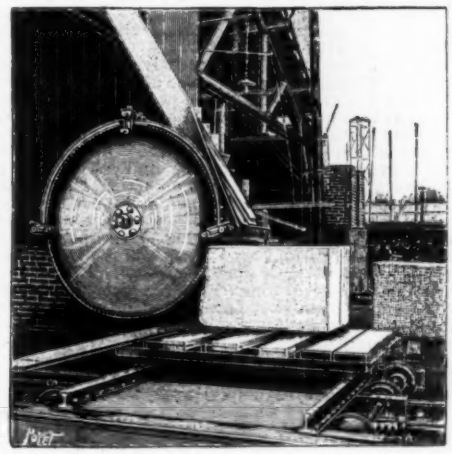


FIG. 3.—FRONT VIEW.

For hard stone, the saw blade employed is 7¼ feet in diameter and carries 200 diamonds—40 on the periphery, 80 upon the edges, and 80 upon the faces. The blade then runs at a speed of 300 revolutions a minute.

For soft stones, the saw blade is of the same diameter and is provided with steel teeth set into notches and held by screws. Every fifth tooth is replaced by a piece of steel shorter than the teeth and carrying a diamond at each side. It runs at a speed of 12 revolutions a minnte.

The block to be sawed is mounted upon carriages of which the motion is controlled by the engine.

For the above particulars and the illustrations we are indebted to La Nature.

Two large transports for the use of the navy are asked for by Secretary of the Navy Long, in a letter to Congress requesting the insertion of this item in the naval appropriation bill. The vessels called for would be twin screw, steel ships, of about 7,000 tons displacement, with a maximum speed of 18 knots and to cost not more than $1,250,000 each. Such a transport would carry 1,200 men and their officers, with all regimental supplies, wagon trains, ammunition, hospital stores, etc. Distilling and refrigerating apparatus would be supplied. The argument for the building of special transports is that existing merchant ships cannot be properly adapted to this purpose. All horses would be transported on separate ships of the usual type. As the army is strongly opposed to giving up the transport of troops, it is expected that this request will cause considerable controversy in Congress. Inspector-General Breckinridge, in his annual report, favors, however, the naval control of the transport service, and this is in accordance with foreign practice.

New inventions of Leonardo da Vinci are constantly coming to light. It is now said that for centuries after his death, the burghers of Milan minced meat for their sausages with a machine invented by the great painter and engineer. It is also believed that he had a diving dress of his own, but he did not believe in disclosing his invention, for he says, "in view of the wickedness of man, I do not divulge the method I have invented for remaining under the sea; for they would make use of it in order to commit murder at the bottom of the sea by destroying vessels and causing them to sink, together with those on board."

ACETYLENE.*

By VIVIAN B. LEWES, Professor of Chemistry, Royal Naval College, Greenwich.

IN my last lecture I pointed out that Edmund Davy first made acetylene from a compound produced during the manufacture of potassium from potassic tartrate and charcoal, which under certain circumstances yielded a black compound decomposed by water with considerable violence and the evolution of acetylene.

This compound was afterward fully investigated by Berzelius, who showed it to be carbide of potassium. He also made the corresponding sodium compound and showed that it evolved the same gas, while in 1862 Woehler first made carbide of calcium, and found that water decomposed it into lime and acetylene.

During the past few years a wordy war has raged as to whether the discovery of the processes by which calcic carbide is now produced is due to the French chemist Moissan or to the Canadian experimentalist Willson, and many still seem to imagine that it is the discovery of calcic carbide and acetylene that is in question. In point of fact, our knowledge has advanced but little, save in details, since the labors of Davy, Woehler, and Berthelot, clearly defined the preparation and properties of this beautiful illuminant, and the only question in dispute is as to who translated the manufacture of carbide and the preparation of acetylene from the ranks of a laboratory experiment of mere scientific interest to a commercial success.

Carron, in 1860, obtained an alloy of calcium and zinc by heating lime and zinc to a high temperature, and Woehler made his calcic carbide by heating to a very high temperature a mixture of lime, zinc, and carbon, which first formed the calcium zinc alloy and then the carbide, the zinc being volatilized, and the compound which he obtained was impure and very unlike the beautiful crystalline substance obtained at the present time

It was Sir Humphry Davy who first demonstrated the heat and light of the electric arc, and it was late in the seventies that Sir William Siemens inaugurated an entirely new era in experimental and metallurgical work by patenting his electrical furnace, in which the electrical energy could be converted into heat, thus yielding a temperature which had never been before available, and which has been estimated by Violle as approximating to 3,500° C. As gradually the utility of the electrical furnace came to be recognized, other patents began to be taken out, Bradley patenting a furnace in 1883, while Cowles took out his patents in 1885, and in 1886 patented a lining of lime and carbon for the furnace as being more refractory. Although these furnaces were used for making aluminum, large quantities of carbide of calcium were accidentally made by the action of the heat on the furnace lining, and during 1886 and 1887 the lads employed in the works used often to amuse themselves in the dinner hour by putting water on the old crucible linings and igniting the gas which was set free. Even before this date it was recognized and published that in the Cowles electric furnace the oxides, not only of the alkaline metals, but of calcium, magnesium, aluminum, silicon, and boron, could be reduced in the presence of carbon and could be made to form alloys with other metals present, while with aluminum and other metals the crystalline compound made with carbon could be obtained, and, further, that silicon and the compound of silicon with carbon could be produced.

It is clear, therefore, that as early as 1886 calcic carbide was made in the electric furnace, but its formation was merely accidental, and no commercial importance was attached to it.

Soon after this date Willson conceived the idea of reducing aluminum in the presence of copper to make aluminum bronze, and employed practically the same method as that used by Cowles, but as his attempts to make the bronze were not successful, and as he was unable to make aluminum owing to the Cowles patents, he attempted to reduce magnesium and calcium to the metallic state. It was in the spring of 1892 that he attempted to reduce lime by carbon, and he found that he obtained by this means a fused bath, the boiling of which caused the short circuiting of the electric arc, and in order to prevent this spitting of the liquid and the unequal loading of the dynamo which interfered seriously with the working of the machinery and water turbines, he added to it carbon, which prevented the splashing of the liquid against the sides of the electrode, the only portion of the surface exposed being in the immediate path of the arc.

It was in the May of 1892 that carbide was obtained by Willson in quantity, and samples were sent by him to various scientific friends in America, and it was on September 16, 1892, that he privately sent specimens of his carbide to Lord Kelvin with a letter. A copy of this letter I have seen in Willson's letter book, and it amply proves that he was perfectly aware of the importance of this product. It was acknowledged by Lord Kelvin in a letter dated October 3, 1892.

About this time M. Moissan was conducting his classical researches on chemical actions at high temperatures, using for his experimental work an electrical furnace identical with the one patented by Siemens in 1879. While experimenting with calcium he found that the vapors of the metal acted on the carbon electrodes, forming calcic carbide in small quantities, a fact which he incidentally mentioned in a paper read before the Academie des Sciences on December 12, 1892. This discovery contained no more of the germs of a commercially possible manufacture than had the discovery of calcic carbide by Woehler, or the attempts of Borchers to make calcic carbide in his experimental furnace, which had extended from 1885 to 1891. Borchers had succeeded in making this body, although he had no idea of the importance of his investigations, which certainly were not of a practical kind.

The history of the manufacture of the carbides was also added to in this year by M. L. Maquenne, who showed, on October 17, 1892, that barium carbide could be made by heating barium carbonate with magnesium in the state of powder and charcoal; while Mr. Travers, on February 6, 1893, published his method of making carbide of calcium by heating a mixture of chloride of calcium with metallic sodium and carbon.

It is quite clear that up to the end of 1892 it was Willson, and Willson only, who had made calcic carbide on anything like a large scale, and nothing would ever have been heard of this material on a commercial scale had it not been that he, in attempting to get capital invested in his process, came across several men of sound, practical knowledge, whose business instincts led them to grasp the possibilities of carbide and acetylene, and no sooner had these commercial possibilities been noised abroad than others began to try and make capital from them. In France, in 1894, Bullier took out a patent for the preparation of the carbides of the alkaline earths based on Moissan's researches. M. Moissan himself has never claimed priority in the manufacture of commercial carbide, and, indeed, while lecturing before the New York section of the Society of Chemical Industry, on October 26, 1896, he distinctly stated that the credit of the first production of calcic carbide on a commercial scale, and the industrial utilization of acetylene, belonged to the Americans, and it seems to me that when this is shown on Moissan's own evidence, further comment is needless.

Willson continued his experiments on the manufacture of carbide on a commercial scale through 1892 and 1893, and having formed a company, of which Major Morehead was the president, the manufacture was continued at the works at Spray, in North Carolina, in which a dynamo, worked by water power, and generating a current of 2,000 amperes and 25 volts, was employed.

By this time the manufacture of carbide was well launched, and the first English plant for its production was erected at Leeds, while later on a large installation driven by water power was erected at Foyers and has been working ever since. This is the source from which nearly all the self-titled manufacturers of calcic carbide in this country obtain their supplies.

On the Continent at the present moment large numbers of works have been erected, while others are in progress; the rapid demand for carbide which has arisen owing to the introduction of acetylene for railway carriage lighting and the illumination of small towns has outstripped the supply, and from time to time carbide famines are threatened, while the price of the material fluctuates considerably. Practically the same condition exists in America, although the output amounts to between 10,000 and 12,000 tons per annum, so that although the manufacturers of generators in this country are fond of grumbling at their orders not being filled as rapidly as they wish, they may console themselves with the fact that they are far better off than their rivals in most parts of the world. Even in Germany, which claims pre-eminence in the various branches of chemical manufacture, they obtain up to the present by far the largest portion of the supply of carbide from Switzerland, where the works at Neuhausen turn the carbide out at a lower price than can be charged by the Bitterfeld Works in Prussian Saxony, which had used steam instead of water power. The latter company, however, has now removed its plant to Neuhausen, where it will reopen with water power for the generators, and is erecting works capable of turning out a very large yield.

The reports of Mr. Frank H. Mason, the American Consul-General at Frankfort, which constitute perhaps the most valuable contribution to our knowledge of Continental industries, owing to the writer's great practical experience and the accuracy of his information, point out that the whole of the carbide industry, so far as Central Europe is concerned, is now in a transition stage. The conditions of supply and price are likely to be greatly modified by the enormous increase of production which is now being arranged for, as not only have the factories in Germany, Austria, and Switzerland, at work and in course of construction, arranged for the utilization of 85,000 horse power to be devoted to this purpose, but another important accession will come through the operations of a big combination, headed by the Schukert Electrical Manufacturing Company, of Nuremberg. This company expects to have in operation during the course of this year works in various parts of Europe where water power can be obtained cheaply, to the amount of about 18,000 horse power, capable of producing some 20,000 tons of carbide per annum. There are also ten factories at work in France, while four others are in course of construction.

In the manufacture of calcic carbide in the electric furnace, lime and hard metallurgical coke, of the highest possible degree of purity, are employed. A good working mixture of these materials may be taken as being 100 parts by weight of lime with 68 parts by weight of carbonaceous material, and about 1·8 pounds of this is used up for each pound of carbide produced. It must not be forgotten, in computing the cost of carbide, that lime of sufficient purity for the purpose is not only costly, but difficult to obtain in large quantities.

It is found that as the ingot of calcic carbide is formed in the furnace, although the ingot itself consists of pure crystalline calcic carbide, it is nearly always surrounded by a crust in which the carbide contains a certain proportion of imperfectly converted constituents, which, therefore, give a lower yield of acetylene than the carbide itself, and in breaking up and sending out the carbide for commercial work, packed in airtight drums, the worst of the crust is, as far as possible, picked out and rejected. It is, perhaps, misleading to state the amount made per E. H. P., as a certain amount of loss is of necessity entailed during the breaking down and packing. For instance, in practical working I have found that while the furnace return was 0·504 pound per kilowatt hour, this amount has been brought down to 0·406 pound per kilowatt hour when the material has been broken up, sorted, and packed in airtight drums.

It will be sufficient for practical purposes to state that the cost of material, labor, and wear and tear of plant, independent of the power used in the electric furnace but inclusive of packing, for making a ton of packed carbide will amount to from £3 to £4, according to locality, and this, of course, entirely governs the cost of the materials used, while the cost of the electrical horse power necessary for the conversion of the material will entirely depend on whether it is obtained from steam, gas engines, or water power, the latter where obtainable being the cheapest, and in this country costing nearly £4 per E.H.P. per year.

The two principal processes utilized in making calcic carbide by electrical power are the ingot process and the tapping process.

In the ingot process, the coke and lime are finely ground, and carefully mixed in the right proportions to suit the chemical actions involved. The arc is struck in a crucible, and the powdered mixture allowed to flow in, and partially fill the crucible. An ingot gradually builds up from the bottom of the crucible, the carbon electrode being raised from time to time automatically or by hand to suit the diminution of resistance due to the shortening of the arc by the rising ingot. The crucible is of metal, and considerably larger than the ingot, the latter being surrounded by a mass of unreduced material which protects the crucible from the intense heat. When the ingot has been made and the crucible is full, the latter is withdrawn, and another substituted. The process is not continuous, but a change of crucibles only takes two or three minutes under the best conditions, and only occurs once in every ten or fifteen hours. The essence of this process is that the coke and lime are only heated to the point of combination, and are not "boiled" after being formed.

In the tapping process a fixed crucible is used lined with carbon. The electrode is nearly as big as the crucible, and a much higher current density is used. Fine grinding is unnecessary, as combination probably only takes place after fusion of the raw materials which mix more or less as liquids. The carbide is heated to complete liquefaction, and tapped at short intervals. There is no unreduced material, and the process is considerably simplified, while less expensive plant is required; but on the other hand, the output in carbide per E. H. P. per day is considerably less than in the ingot process, and it is only more economical where power is comparatively cheap.

Many attempts have been made to economize the amount of current necessary in making the carbide by heating a mixture of lime and carbonaceous material before exposing it to the action of the arc, but it has never been clearly demonstrated that any economy has been gained by doing this.

When the manufacture of calcic carbide was in its infancy, the idea of preheating the constituents to save the current was a favorite one with inventors, and a large number of patents were taken out for electric furnaces working on this principle, but with extended practice the fallacy of this economy has become apparent.

The best carbide is made when a finely powdered and intimate mixture of pure lime and coke of very low ash is presented to the action of the arc for just sufficient time to fuse it and convert it into carbide; if, however, attempts are made to preheat this mixture by exterior heating, some of the carbon is burnt away and the proportion of carbon to lime altered, while if interior heating be attempted, the rush of hot gases carries away the lighter particles and destroys the homogeneous nature of the mixture in that way as well as by burning off carbon. If attempts be then made to overcome these evils by using a coarsely ground mixture of the ingredients, a bad carbide is produced, owing to the interaction between the carbon and the lime never being properly completed. In attempting to overcome this last trouble the material is often kept too long in the arc, thereby lowering the quality of the carbide still further by overheating.

M. Nicolai has shown that overheating leads to dissociation of some of the carbide, and the result of this is well shown by remelting a sample of carbide of known composition, after which it develops about 12 per cent. less gas than before, while a second remelting more than doubles the loss. A second grave disadvantage of overheating also is that metallic calcium is produced, which during the decomposition of the carbide by water, gives rise to hydrogen.

In one class of furnace the raw coke and lime are heated before entering the furnace crucible by being placed in a metal bin subjected to the action of the hot furnace gases, and sometimes heated by a fire underneath.

Pictet places a mixture of comparatively large pieces of lime and coke, with a considerable excess of the latter, in a refractory crucible which has a hole at the bottom, below which a horizontal arc furnace is situated. A row of tuyeres round the upper part of the crucible supplies a hot air blast which consumes some of the coke that has been previously ignited, and thereby heats the descending charge. A second row of tuyeres lower down in the crucible supplies water gas and hot air simultaneously, and heats the mixture to a still higher temperature. The mixture then passes out between the carbon poles, and the carbide is said to be made. Here, again, it is very doubtful whether the economy claimed for this process is borne out in practice, as the gain from the prior heating of the material, if any, is more than counterbalanced by the difficulty of reducing the large lumps, while the expense of the water gas and air blast would be no small item, and the quality of the carbide in all probability would not be of the best.

There is a rotating furnace which is used in one large works in the United States, and modifications of this are, I believe, being tested by Mr. Willson, and have been fitted up at Niagara.

A rotating drum of cast iron is fitted round its periphery with a number of removable iron plates, thus forming an annular space on the outside. The carbon electrodes are placed in a hopper made of refractory material at one side of the drum, the electrodes being parallel to two opposite sides of the hopper, and meeting with the formation of an arc just over the annular space in the drum. Only one-half or two-thirds of this annular space is closed at one time, the closed part extending from just below the hopper to the other side downward. A mixture of powdered coke and lime is fed into the hopper, some falling between the electrodes, which are then drawn apart as carbide is formed until a block of carbide four or five inches thick is built up between the electrodes, while an arc plays on both sides of the block between them. The electrodes are not clamped down, and as the ingot tends to short-circuit the arcs, the drum is rotated a little by means of worm gearing, thereby drawing a little of the ingot and mixture into the annular space and introducing more raw material to the arc.

This process goes on continuously until the carbon poles are exhausted; the carbide forms round the drum and is broken off in pieces on the other side by removing the periphery plates as they come round.

I have had the good fortune to be able to secure photographs of some of the most interesting machinery connected with the carbide manufacture, and you will

* Lecture II., delivered November 28, 1898, before the Society of Arts.

see that the plant used at nearly all the large factories may be looked upon as developments of Willson's original plant as used at Spray—the figure of which on the wall I think is of exceptional interest.

During the past year the air has been full of reports as to various processes for making carbide without the aid of electricity, and it is said that this has been successfully accomplished; but I confess that until I have the evidence of my own senses to go upon, I shall remain skeptical as to the carbide being produced more economically by such means than by electricity, even if produced at all on a large scale.

In 1894 and 1895 I made many experiments in this direction, built up small experimental plant, and used every method for generating high temperatures that was available, and succeeded in fusing practically everything save the mixture of lime and carbon. It was an easy matter to run down the lining of the furnace, indeed, to melt up the whole furnace itself, but the direct combination of the carbon with the lime was not to be obtained in that way.

It then seemed probable that the result might be obtained by highly heating lime in the presence of decomposing hydrocarbons, so that the nascent carbon might combine with the lime at the moment of its liberation; but this was tried in many different ways without any very encouraging results, although it is possible by decomposing such organic compounds as calcic tartrate by heat, and raising the temperature of the mass, to get traces produced; the price, however, under these conditions of the organic compounds, would be prohibitive.

Another point which always seemed to me to be against the direct formation of calcic carbide by heat is that the temperature needed for its formation is 2,700° C., and if you take calcic carbide and attempt to fuse it at any obtainable temperature short of the electric arc, you fail to do so, while if the oxyhydrogen blowpipe be used for this purpose, not only do you fail to fuse the carbide, but you decompose that which you already have, and the lump which you have left behind consists mainly of carbon, carbonate of lime, and lime. It is possible, however, that by using carbon burning in oxygen a sufficient temperature could be reached to fuse the mixture of lime and carbon with the formation of carbide, but the temperature which would do this would prove fatal to the furnace itself. There is not the slightest doubt that the next year will see very many experiments made with gaseous mixtures, rich in oxygen, made at a remarkably cheap rate by methods such as the Linde process for liquefying air and allowing the nitrogen to boil off, and some of these may be successful in overcoming the existing difficulty.

It is reported that Dr. Borchers has succeeded in making carbide by some method akin to this, but there are many considerations which lead to the belief that even if this feat has been accomplished, its practical value will be but little. Given water gas, regenerative settings, and cheap oxygen, an enormously high temperature can be obtained, but the material of which to build a crucible or furnace that will stand it has yet to be discovered.

In using the electric furnace the intense heat of the electric arc is generated in the center of the mass to be fused by it and so the wear and tear to the furnace is avoided, but this would be impossible even if the requisite temperature could be reached by a combustion process, and the result would be that the electrical heating would probably be less expensive than the other.

It is perfectly well known that if a temperature commercially practicable is to be used, some metal with a strong affinity for oxygen must be employed to reduce the lime to calcium before combination with the carbon will take place. Such metals as will do this, potassium, sodium, and magnesium, or even zinc, are, however, costly, and if a process were devised in which the vapors of such metals were liberated by reduction from their salts, and were made to interact with carbon and lime at a high temperature, it could only be made commercially possible either by a large demand being created for the by-products or by its being capable of being cheaply worked up and used over again. In either case the probabilities are that the cost would exceed that of making carbide by electricity generated by water power.

Another point of a purely unscientific character is that during the past few months very large amounts of capital have been subscribed for the erection of factories for making carbide by water power on the Continent, and practically little or none can be traced for processes for making carbide without electricity, which shows no great amount of confidence in the many schemes suggested.

There is a company at Leipsic, having works at Cassel, who are supposed to make calcic carbide without electricity, by smelting the constituents by acetylene blowpipes, working under considerable pressure, but it does not appear possible that this could be made to compete economically with the ordinary electrical method.

One of the schemes for the manufacture of carbide is for producing it from blast furnace slag, which contains a certain amount of lime, together with all the impurities derived from the fuel, ore, and limestone used in the furnace. According to the inventor, this mixture is to be run into Bessemer converters, impregnated with coke powder blown into it through the converter trunnion, and then poured out between a series of carbon electrodes, between which a powerful current is flowing, and in twenty minutes this converts the slag into a material named by the inventor "carbolite," and which is supposed, on contact with water, to yield 5 cubic feet of gas per pound. Such a substance might contain 40 per cent. of calcic carbide, but the impurities would be so pronounced that it would be practically useless for the generation of acetylene for indoor lighting.

Carbide of calcium, as formed in the electric furnace, is a beautiful crystalline semi-metallic-looking solid, having a density of 2·22, and showing a fracture which is often shot with iridescent colors. It can be kept unaltered in dry air, but the smallest trace of moisture in the atmosphere leads to the evolution of minute quantities of acetylene, and gives it a distinctive odor. It is infusible at temperatures up to 2,000° C., but can be fused in the electric arc. When heated to a temperature of 245° C. in a stream of chlorine gas it becomes incandescent, forming calcic chloride and liberating carbon, and can also be made to burn in oxygen at a dull red heat, leaving behind a residue of calcic carbonate. Under the same conditions it becomes incandescent in the vapor of sulphur, yielding calcic sulphide and carbon disulphide, while the vapor of phosphorus will also unite with it at a red heat. It is a compound of—

	Per cent.
Calcium	62·5
Carbon	37·5
	100·0

Acted upon by water, calcic carbide is at once decomposed, yielding acetylene and calcic hydrate. Pure crystalline calcic carbide yields from 5·5 to 5·8 cubic feet of acetylene per pound at ordinary temperatures, but the carbide as sold commercially is a mixture of the pure crystalline material with the crust which in the electric furnace surrounds the ingot, and which of course yields less gas. The two being blended together yield an average of 5 cubic feet of gas per pound of carbide under proper conditions of generation; but as we shall see later on, the volume of gas to be obtained from the carbide depends very largely upon the form of apparatus used, and while some will give the full 5 cubic feet, other apparatus will only yield with the same carbide 3¾ feet.

The purity of the carbide entirely depends upon the purity of the materials used in its manufacture, and before this fact had been fully grasped by the manufacturers of carbide, and only the purest material obtainable employed, the carbide contained notable quantities of compounds which, during its decomposition by water, yielded a somewhat high proportion of impurities in the acetylene generated from it. Although at the present time a marvelous improvement has taken place all round in the quality of the carbide produced, the acetylene nearly always contains minute traces of hydrogen, ammonia, sulphureted hydrogen, phosphureted hydrogen, siliciureted hydrogen, nitrogen, and oxygen, and sometimes minute traces of carbon monoxide and dioxide.

The formation of hydrogen is caused by small traces of metallic calcium occasionally found free in the carbide, and cases have been known where this was present in such quantities that the evolved gas contained nearly 20 per cent. of hydrogen. This takes place when, in the manufacture of the carbide, the material is kept too long in contact with the arc, as this overheating causes the dissociation of some of the calcic carbide, and the solution of metallic calcium in the remainder.

The presence of free hydrogen is nearly always accompanied by siliciureted hydrogen, which is formed by the combination of the nascent hydrogen with silicon in the carbide. It has usually been stated that this siliciureted hydrogen has been formed by the decomposition of silicides present in the carbide, but in spite of a long series of experiments which I have made I have never yet been able to form a metallic silicide which will decompose with water with the evolution of this gas, and the silicides which analyses prove to be present in the carbide are certainly not decomposed in this way.

The ammonia found in the acetylene is due to the presence of magnesium nitride in the carbide, and this is formed by the metallic magnesium in the molten condition in the ingot taking up nitrogen from the air, and when this comes to be decomposed by water, ammonia is produced by the action of steam or of nascent hydrogen on the nitride, the quantity formed, however, depending very largely upon the temperature at which the carbide is decomposed.

The formation of nitrides by actions of this kind and their easy conversion into ammonia will probably, at some no very distant date, prove to be a useful method of fixing the nitrogen of the atmosphere and rendering it available for manurial purposes, although it could never compete in price with the ammonia formed in the destructive distillation of coal for coal gas.

Sulphureted hydrogen, which is invariably present in commercial acetylene, is formed by the decomposition of aluminum sulphide, and it has been shown by Murlot that aluminum sulphide, zinc sulphide and cadmium sulphide are the only sulphur compounds which can resist the heat of the electric furnace without decomposition or volatilization, and of these aluminum sulphide is the only one which is decomposed by water with the evolution of sulphureted hydrogen.

In the early samples of carbide this compound used to be present in consid erable quantity, but now it has been reduced to so small a limit that one rarely finds more than one-tenth per cent. of sulphureted hydrogen in the acetylene generated from commercial carbide.

Phosphureted hydrogen, one of the most important impurities, which has been blamed for the haze formed by the combustion of acetylene under certain conditions, is produced by the action of water upon traces of calcic phosphide found in carbide. Although at first it was no uncommon thing to find half a per cent. of phosphureted hydrogen present in the acetylene, this has now been so reduced by the use of pure materials that the average quantity is rarely above one fifteen-hundredth of a per cent. and it is often not one-fifth of that.

I have made many experiments on the effect of the impurities in calcic carbide upon the safety of the material, and have come to the conclusion that such impurities as are now found in the commercial carbide may be looked upon as practically innocuous. With proper care and supervision in the selection of the materials for making the carbide, all trouble on that score may be disregarded, as spontaneous ignition due to the liberation of phosphureted hydrogen would be the chief risk dependent upon the use of the impure material.

In the earlier days of carbide manufacture several cases of spontaneous ignition of the gas occurred, and although the analyses of many different brands of carbide from all countries of the world show that in the carbide itself there is not sufficient impurity to bring about this result, it seemed possible that the concentration of the phosphorus compounds might take place in the outer crust formed around the ingot during manufacture, and experiments were made to see if this were so.

By the courtesy of the Acetylene Illuminating Company, a portion of an ingot with its crust intact was obtained, the crystalline material of the ingot containing 96·7 per cent. of true carbide, while the crust, although varying very much in composition according to its distance from the ingot, contained an average of 51·9 per cent. of carbide. A second couple of ingot and crust gave even better results, the ingot containing 90 per cent. of carbide and the crust 77 per cent.

Analyses were made of the acetylene from these samples, but the results showed no indication of the poorer material being richer in phosphorus compounds than the ingot itself.

On breaking up some ingots of calcic carbide, metallic nodules manifestly differing from the pure carbide are observed, and are far more abundant in specimens of foreign manufacture than in English-made carbide. These nodules are generally found in a spherical or oval shape, and have evidently separated from the molten mass on the crystallizing of the true carbide.

From this it seemed highly probable that a concentration of the impurities might take place, and that the presence of these nodules might be an active source of danger.

In order to verify this point calcic carbide was obtained in bulk, and both English and foreign makes were represented. This carbide was then carefully broken up, and the nodules and anything which appeared to differ from the true carbide were collected. The nodules differed somewhat in appearance, two distinct varieties being clearly noticeable:

(a) Gray nodules, not attracted by the magnet, not oxidized when exposed to air or heated as a solid lump in the blowpipe flame. Specific gravity, 3·5 to 5·8. In a fine powder some had a very faint garlic-like odor, gained 5 per cent. when heated for half an hour, and attacked platinum when heated on it for some time. These nodules gave no gas when acted upon by water.

(b) Steel-like nodules, which were strongly magnetic, and became coated with iron rust when exposed to moisture and air for some time, and which gave no gas when acted on by water. Specific gravity, 6·3 to 6·8.

Analysis showed that the foreign matter present in the carbide consisted of carborundum or silicide of carbon, metallic silicides, iron, occasionally metallic calcium, magnesium, aluminum, and traces of nitrides, phosphorus, and sulphur compounds. One of the nodules on analysis yielded:

	Per cent.
Silicon	30·76
Iron	58·06
Calcium	2·65
Aluminum	3·01
Magnesium	0 64
Carbon, etc.	4·89
	100·00

None of these substances gave spontaneously inflammable gases when acted upon by water, but in a few instances a nodule was found which evidently contained magnesium silicide, and which when powdered and acted upon by hydrochloric acid, gave a few bubbles of spontaneously inflammable gas.

M. C. Gerard, chief of the Municipal Laboratory at the Prefecture of Police, Paris, has also analyzed some of these nodules, with the following results, and found that these alloys, pulverized and treated with concentrated acid, gave off siliciureted hydrogen:

	I. Per cent.	II. Per cent.
Iron	55·027	53·250
Silicon	32·172	31·800
Aluminum	5·579	8·910
Calcium	2·764	4·120
Not determined and loss	3·458	19·20
	100·000	100·000

In some cases it was found that the carbon deposited by holding a cold surface in an acetylene flame contained traces of silica, and this seems to support the idea that siliciureted hydrogen may occur in the acetylene, but, if it does, the amount is so small as certainly to give no danger of spontaneous ignition.

A sample of gas which appeared to give a considerable quantity of silica was burnt under such conditions as to allow of the silica being collected, and on estimating the quantity formed it was found to correspond to 0·01 per cent. of siliciureted hydrogen in the original gas.

M. Gerard also carried out a number of extremely interesting experiments upon the products found in the residues left after treating the calcic carbide with water, and succeeded in extracting from them minute diamonds. The residues were, as far as possible, dissolved in hydrochloric acid, and the insoluble portion separated by filtration and washing with water, and the metallic portions separated by sieving. The finer portions were collected in a filter paper, washed and dried, and were then heated with potash in a silver capsule, and the insoluble portion treated with aqua regia. After repeating this drastic treatment two or three times, the residue was put into a separating funnel containing a saturated solution of the double iodide of mercury and potassium, which has a density of 2·9, in which silicide of carbon will float, while graphite sinks. This silicide of carbon is then purified by being treated several times with concentrated hydrofluoric acid, and after washing is dried, while the graphite bodies are treated and separated with iodide of methylene, which has a density of 3·29. The separation of diamondiferous bodies from the silicides of carbon is effected by a saturated solution of cadmium bromotungstate or iodide of barium and mercury.

The labor entailed in the separation of this diamond-containing powder may be estimated, when it is stated that it was necessary to treat no less than between 700 and 900 lb. of carbide in order to obtain 15·4 grains of this material.

The evidence upon which M. Gerard bases his assumption, that these minute crystals are in reality diamonds formed at the intense temperature of the arc, is that when they are burnt in oxygen they yield nearly the theoretical volume of carbon dioxide. M. Moissan has failed to find diamonds in the specimens of carbide he has examined, but this is probably due to the quantities worked with, being far smaller than those treated by M. Gerard.

There is no more risk in the storage of calcic car-

bide than there is in storing any other inert material, provided it is packed dry and warm in hermetically sealed drums, so as to render it impossible for it to come in contact with water or moist air.

The real risk is in the removal or redistribution of the material, as, after opening a drum, it may not be again properly closed, and if the drum be left in this condition in the moist air of an ill-ventilated cellar, it is quite possible for a slow generation of gas to take place, and an explosive mixture to be formed by its accumulation.

All carbide stores should be thoroughly ventilated and above ground, and when this is the case, all danger is practically done away with.

For the carriage of carbide it is important that not only should the drums be airtight, but that they should be of sufficient strength to resist the rough usage incidental to the handling of a heavy product, and where tins are used, they should always be protected by an exterior wood case.

A CURIOUS PROFESSION.

THE profession of a "lawyer model-maker" is a curious one. It is seldom that a lawyer passes from a law office to a carpenter shop, but such is the case in one instance in New York where a lawyer is now engaged in manufacturing models for his brother lawyers. Instead of drawing up routine papers and serving notices upon witnesses and attempting to reverse the law of supply and demand, he has gone into a field where the demand was good and the supply was limited. The firm with which he has spent years of his life is distinguished for its skill in defending actions brought to recover damages alleged to be caused by the carelessness of some one or some one's servants. Since we have the cable and trolley road, it is not to be wondered at that suits for damages are more numerous than they were formerly. Protection, therefore, from this modern species of fortune-hunting has become a business that is summoning to its aid many arts and callings, and passenger-carriers are not the only patrons of this business of protection, which is a development of recent years. Owners of plants for the manufacture of products of all kinds are targets for inevitable damage suits in the event of trouble with power in any form. It is no new fact that the business of accident insurance is a considerable one, and that the insurance extends to guaranteeing immunity from liability for money damages.

The method of providing immunity is by contesting every claim, inch by inch, save those which can be settled much cheaper without taking the case into court. As the object lesson, says The Evening Post, from which we glean our particulars, is at the foundation of modern pedagogy, so the eyes as well as the ears of the modern juror must be appealed to in the process of bringing him to a verdict. Formerly a map or diagram, prepared by a city surveyor or a draftsman, showing the place of the accident, and indicating distance and dimensions, was the limit of art in providing for trial. The leading authority in this country that can be cited in the support of the use of photographs to aid a jury in grasping the situation and to enable them to listen to evidence intelligently is nearly a dozen years old. The object lesson method of trying cases has rapidly grown in favor, and one may often see nowadays eminent jurists and astute cross-examiners pushing toy trolley cars up and down little wooden tracks along the jury rail, or the counsel table, or mooring little canal boats to miniature wharves, hoisting and lowering little passenger elevators, operating derricks, or turning wheels of laundry mangles or other machines. The success of this method is shown by litigation which grew out of a boiler explosion. A jury gave one victim a verdict, while a few months later a jury found for the defendant on the same set of facts, the difference between the two trials being in the use of models.

The young man to whom we have referred has a complete carpenter shop, besides facilities for making models out of tin, and he uses a two-roomed suite in an office building on Broadway. Here is also a dark room for the development of negatives of the spot where the accident occurred which he has photographed. He notes all the points regarding the availability of a model to a trial, and will turn out to order almost anything, from a tin model of an illuminating gas tank to a plaster cast of a broken femur.

M. de Negri publishes, in the Giornale de Farmacia, the results of his investigation of the fixed oil of wheat. This, he says, is a limpid, colorless oil, without odor or flavor, which at 15° C. solidifies into a crystalline yellowish mass. It is soluble in ether, benzine, chloroform, carbon disulphide, and in glacial acetic acid at from 1° C. to 65° C. It is also soluble in 30 parts of boiling alcohol, but insoluble in cold alcohol, even absolute. Caustic potash slowly saponifies it. Its color reactions are as follows: Heydenreich's reagent: An orange yellow coloration, with violet striæ. Brulle's reagent: At first a clear rose, which quickly turns to a lively red. In the course of 24 hours it becomes solid. Becchi's reagent: Brown. Schneider's reagent, like that of Baudoin, yields no result. Wheat oil rancidifies easily and quickly. When kept in a hermetically sealed flask for a year, it contained 43·86 per cent. of free acid, estimated as oleic acid.

It may not be generally known that camels were ever used in this country for carrying freight, but The San Francisco Call is authority for the statement that such is the case. It seems that many years ago great difficulty was experienced in transporting ore over a desert some 25 or 30 miles wide, near Virginia City, Nevada. Part of the route lay through a rocky region where vehicles could not be used. To solve the problem a herd of 30 camels was procured, 20 being brought from Asia Minor and the remainder obtained from the noted showman P. T. Barnum. It is said that these animals did the work successfully for several years, carrying two bags of ore, weighing from 300 to 500 pounds each, at a load. Eventually, railroad facilities were at hand and the camels were turned loose to shift for themselves. The last of the herd was recently killed and eaten by Indians near Yuma, Arizona.

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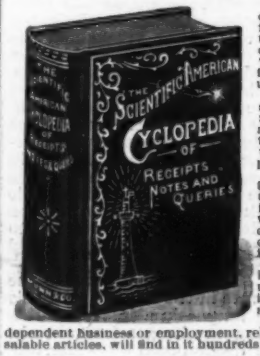

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